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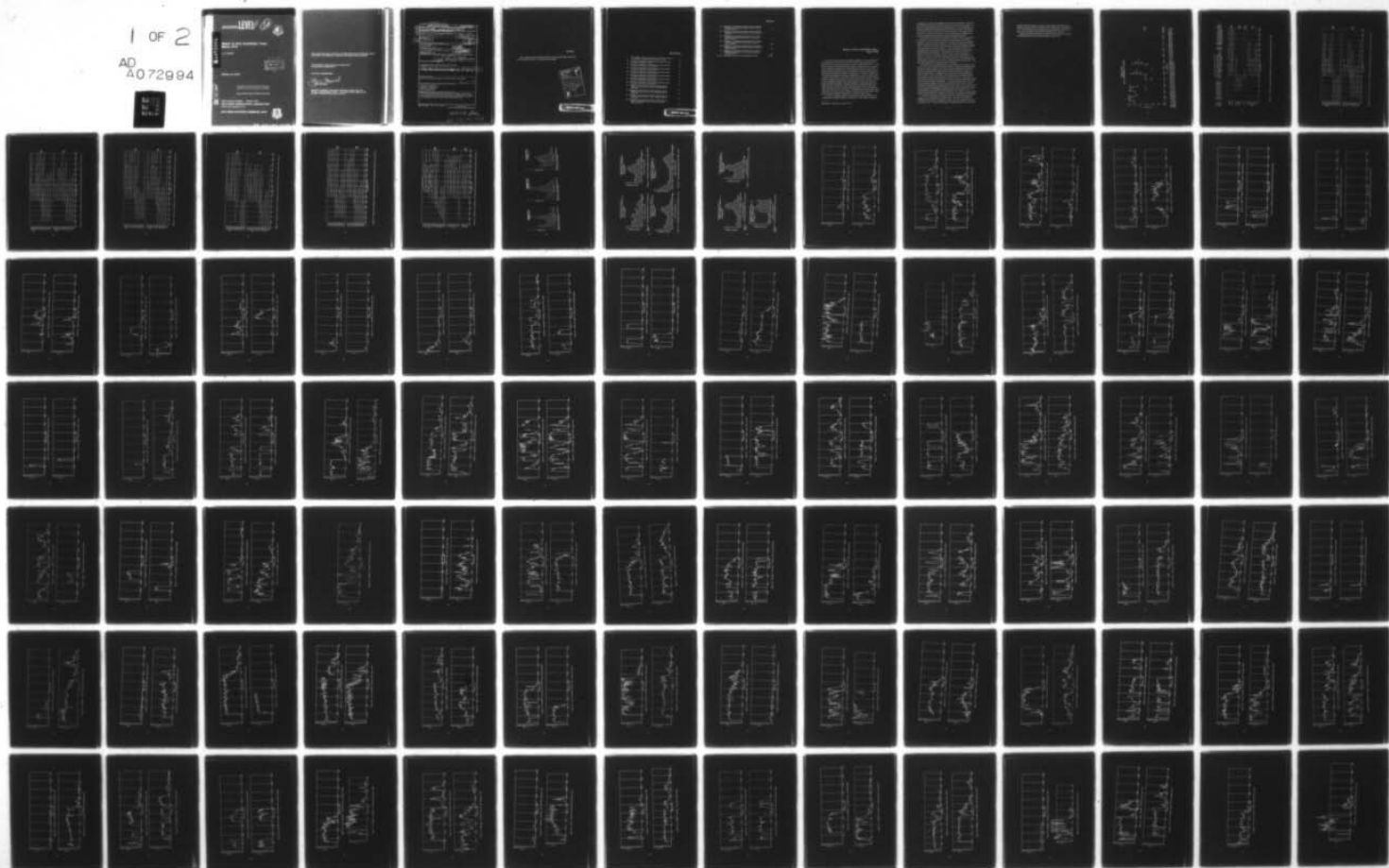
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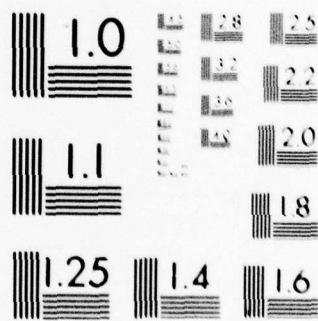
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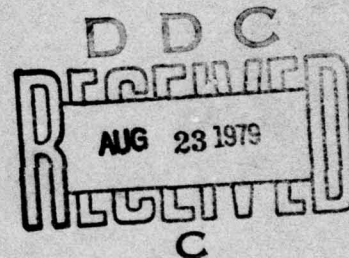
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Report on Peru Scintillation Tests- March 1978

H. E. WHITNEY



22 January 1979

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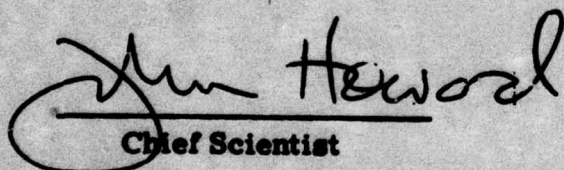
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FOR THE COMMANDER


Chief Scientist

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Preface

The assistance of the Geophysical Institute of Peru and The Federal University of the Northern Rio Grande, is gratefully acknowledged.

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Report on Peru Scintillation Tests— March 1978

The results of two equatorial scintillation campaigns in Peru during October 1976 and March 1977 were reported in AFGL-TR-77-0282, 8 December 1977, titled "Report on Peru Scintillation Tests — October 1976 and March 1977." These tests were developed jointly by AFGL and AFAL to evaluate the effects of equatorial ionospheric irregularities on UHF (250 MHz) satellite communications, to map the temporal and spatial extent of the equatorial scintillation region, and to determine the geophysical mechanisms leading to the formation of irregularities in the equatorial ionosphere and thus to scintillations. Of specific interest were scintillation characteristics and effects observed by airborne terminals and their relation to simultaneously obtained results from ground based terminals. Based on radio propagation and geophysical measurements the test results show the general scintillation patterns, latitudinal dependence, heading dependence and signal statistics. Backscatter measurements from the Jicamarca radar and optical observations from the allsky imaging photometer show the development and motion of the irregularity structure. Scintillation plots for the October 1976 and March 1977 tests for several satellites received at the ground stations and on the aircraft were included as Appendices A and B in the basic report.

A similar campaign was again conducted during the period 28 February to 14 March 1978 to measure equatorial scintillations. The emphasis during this

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campaign was to measure the longitudinal variability of scintillations. The AFGL aircraft and the Jicamarca radar were involved as in the earlier campaigns. In addition to the ground stations at Ancon and Huancayo, Peru measurements were also made at Natal, Brazil, Ascension Island, and Accra, Ghana. The purpose of this report, which is a follow-on to the earlier report, is to present the scintillation plots received at the ground stations during the March campaign and to make a few general observations concerning the scintillation patterns.

The scintillation records for each day were compiled for all the stations and were plotted in a compressed form with the ray path having the most western ionospheric intersection (LES-8 viewed from Ancon) at the top and most eastern (Marisat viewed from Ghana) at the bottom. The variation of the 350 km subionospheric points as seen from the Ancon and Huancayo stations (designated A and H) to various satellites is shown in Figure 1. The subionospheric locations are specified by the station name (A for Ancon and H for Huancayo) followed by the abbreviated name of the satellite. The dotted circles denote the location of Jicamarca, Ancon, and Huancayo stations. When the data is displayed as in Figure 2a - 2g drifts of individual irregularity patches can often be seen by the displacement of the records. At times a westward motion of the developing irregularity patch within about one hour after the sunset terminator can be noted. Once the irregularity region has formed the drift is eastward.

The distribution of scintillation greater than 5 dB is shown in Figure 7 of the earlier report for the October 1976 test period and in Figure 8 for the March 1977 test period. Both histograms have a similar shape showing a null for the mid-range of scintillations and a peak at both the high and low values. Figures 3-5 show the distributions of scintillations recorded at Ancon for the March 1978 tests for LES-9, LES-8, and GOES. The distributions are somewhat different for the March 1978 tests than observed for the previous tests. An increase in the occurrence of high level scintillation is noted for LES-9 and GOES while LES-8 has a more nearly uniform distribution. It is expected that geometry, increase in solar flux and frequency will cause the differences observed for the various distributions obtained at Ancon during the three test periods. For comparison with the Ancon data the distributions of scintillation greater than 5 dB that were measured at Huancayo, Peru and Natal, Brazil are shown in Figures 4a, b, c, d; Ascension Island and Ghana are shown in Figures 5a, b, c. Most of the distributions show the similar feature of a pronounced occurrence of high values of scintillation.

The 1978 test procedures are similar to the ones used in the earlier campaigns which are described in the earlier report. The strip chart records of scintillations received on the ionospheric paths to the various satellites are given in Figures 6-166. The two minute values of scintillation index were reduced and

plotted in the same manner as was done for the October 1976 data shown in Appendix A and for the March 1977 data shown in Appendix B of the earlier report. Each individual record designates the receiving station, satellite, frequency, date and shows the times that scintillations were received.

The analysis of the data obtained during the three test periods is still proceeding and an additional campaign is planned for March 1979.

MARCH 5, 1978
400 km SUBIONOSPHERIC POSITIONS

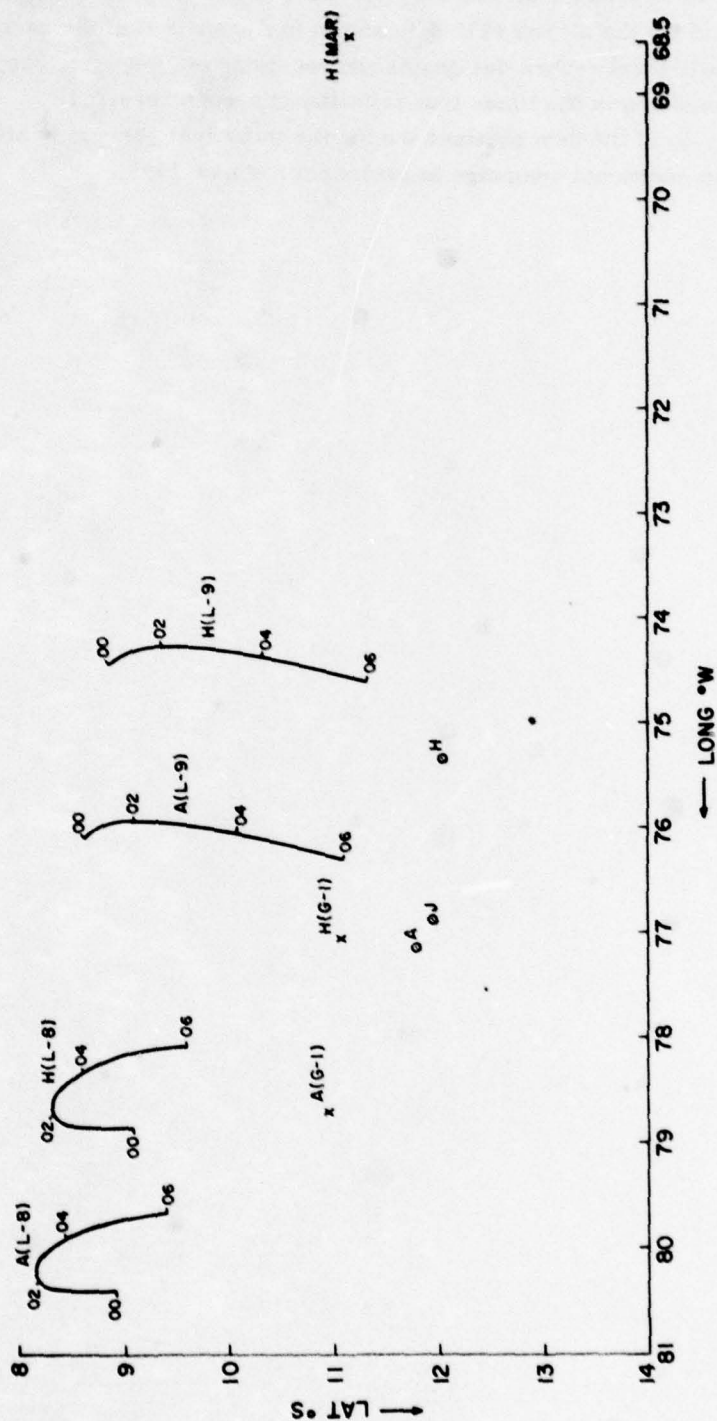


Figure 1. Subionospheric Positions (referred to an altitude of 400 km) of Scintillation Measurements on March 5, 1978. The ground stations at Ancon (A) and Huancayo (H) performing scintillation observations and Jicamarca (J) making radar backscatter observations are indicated in the diagram. The satellites LES-8, GOES-1, LES-9, and MARISAT are abbreviated as L-8, G-1, L-9, MAR, respectively

Explanation of Satellite Abbreviations

L-8(A)	= LES-8, Ancon, Peru, 249 MHz	M _U (N)	= MARISAT, Natal, Brazil, 257 MHz
L-8(H)	= LES-8, Huancayo, Peru, 249 MHz	L-9(AI)	= LES-9, Ascension Island, 249 MHz
A-3(H)	= ATS-3, Huancayo, Peru, 136 MHz	M _U (AI)	= MARISAT, Ascension Island, 257 MHz
GOES(A)	= GOES, Ancon, Peru, 136 MHz	S(AI)	= SIRIO, Ascension Island, 136 MHz
GOES(H)	= GOES, Huancayo, Peru, 136 MHz	M _U (G)	= MARISAT, Ghana, 257 MHz
L-9(A)	= LES-9, Ancon, Peru, 249 MHz		
L-9(H)	= LES-9, Huancayo, Peru, 249 MHz		
M _U (H)	= MARISAT, Huancayo, Peru, 257 MHz		
N _U (H)	= MARISAT, Huancayo, Peru, 1541 MHz		
L-9(N)	= LES-9, Natal, Brazil, 249 MHz		

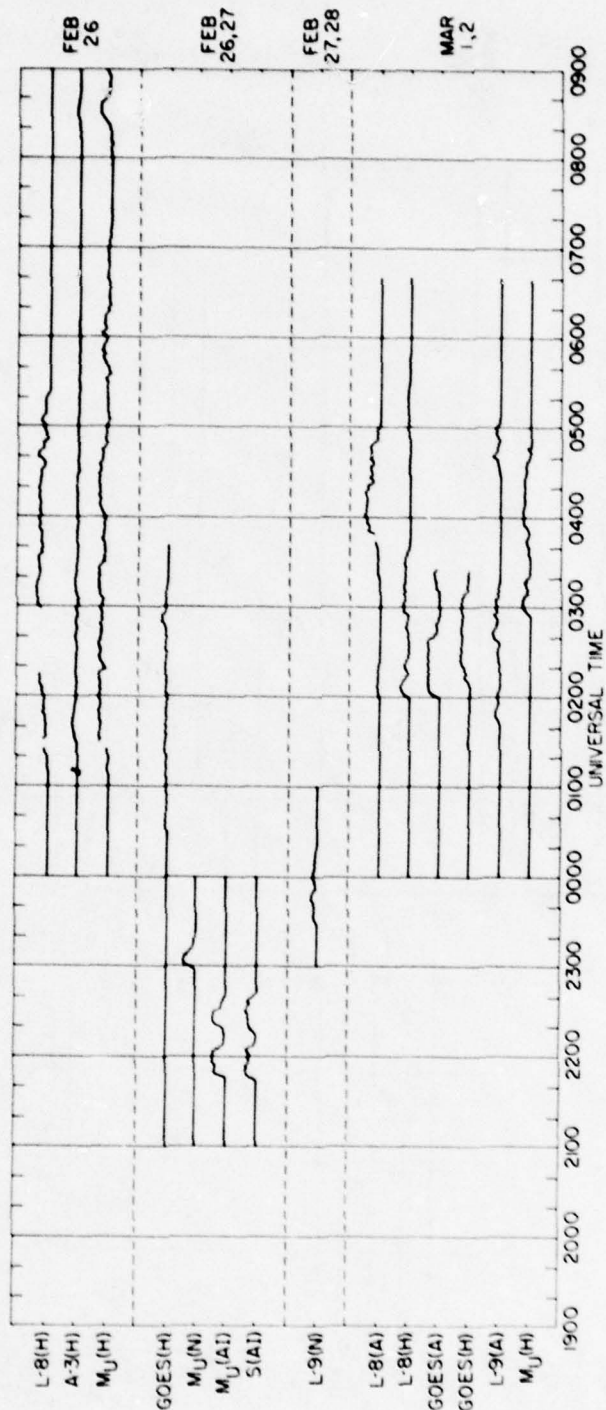


Figure 2a. Summary of Ionospheric Scintillation Occurrence During the March 1978 Test in Peru

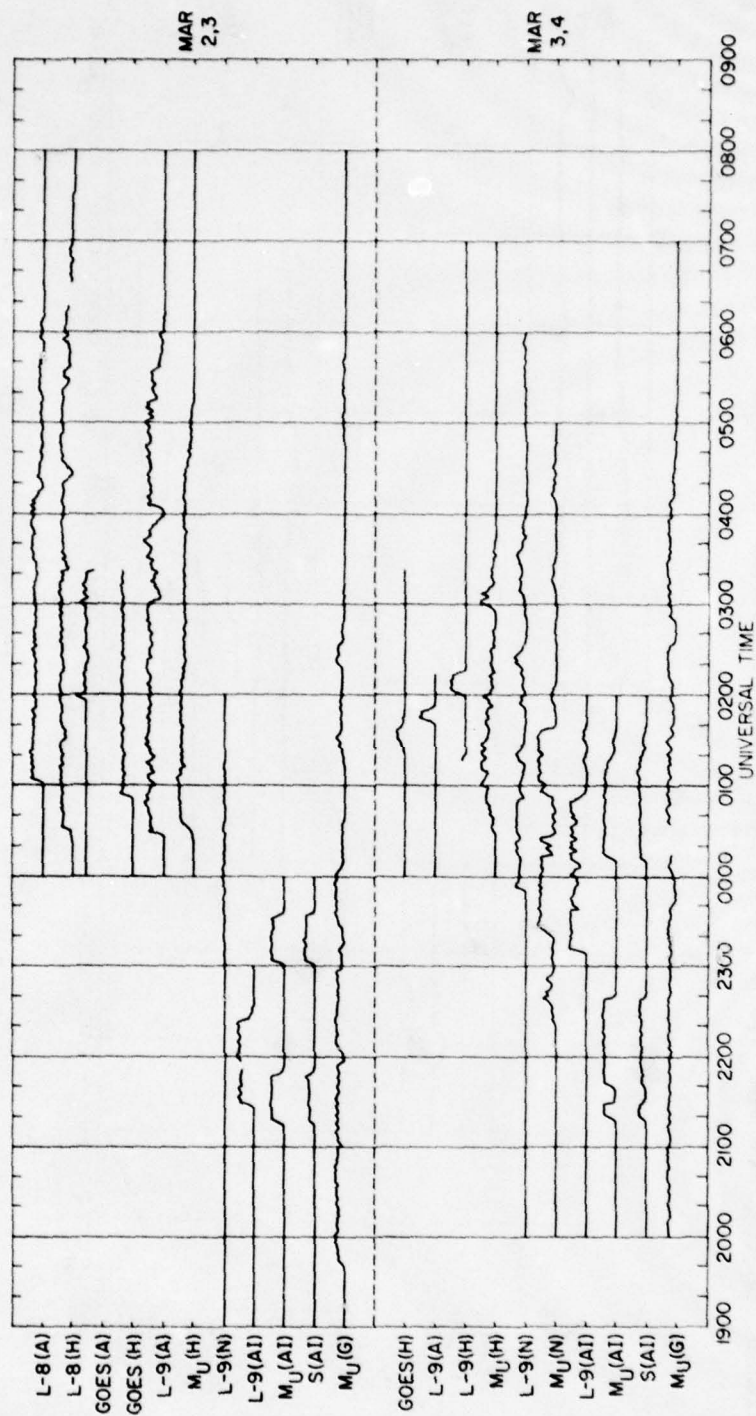


Figure 2b. Summary of Ionospheric Scintillation Occurrence During the March 1978 Test in Peru (Cont.)

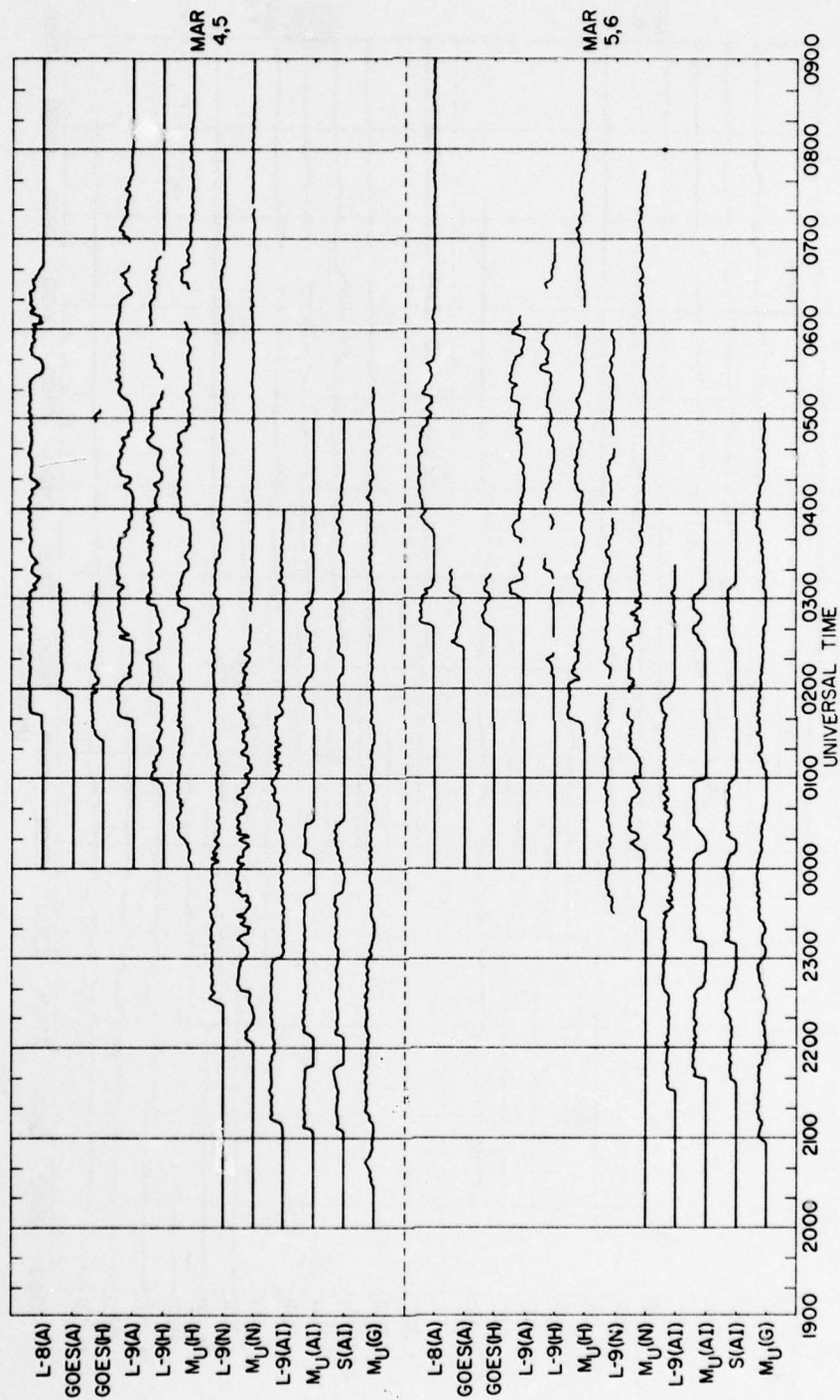


Figure 2c. Summary of Ionospheric Scintillation Occurrence During the March 1978 Test in Peru (Cont.)

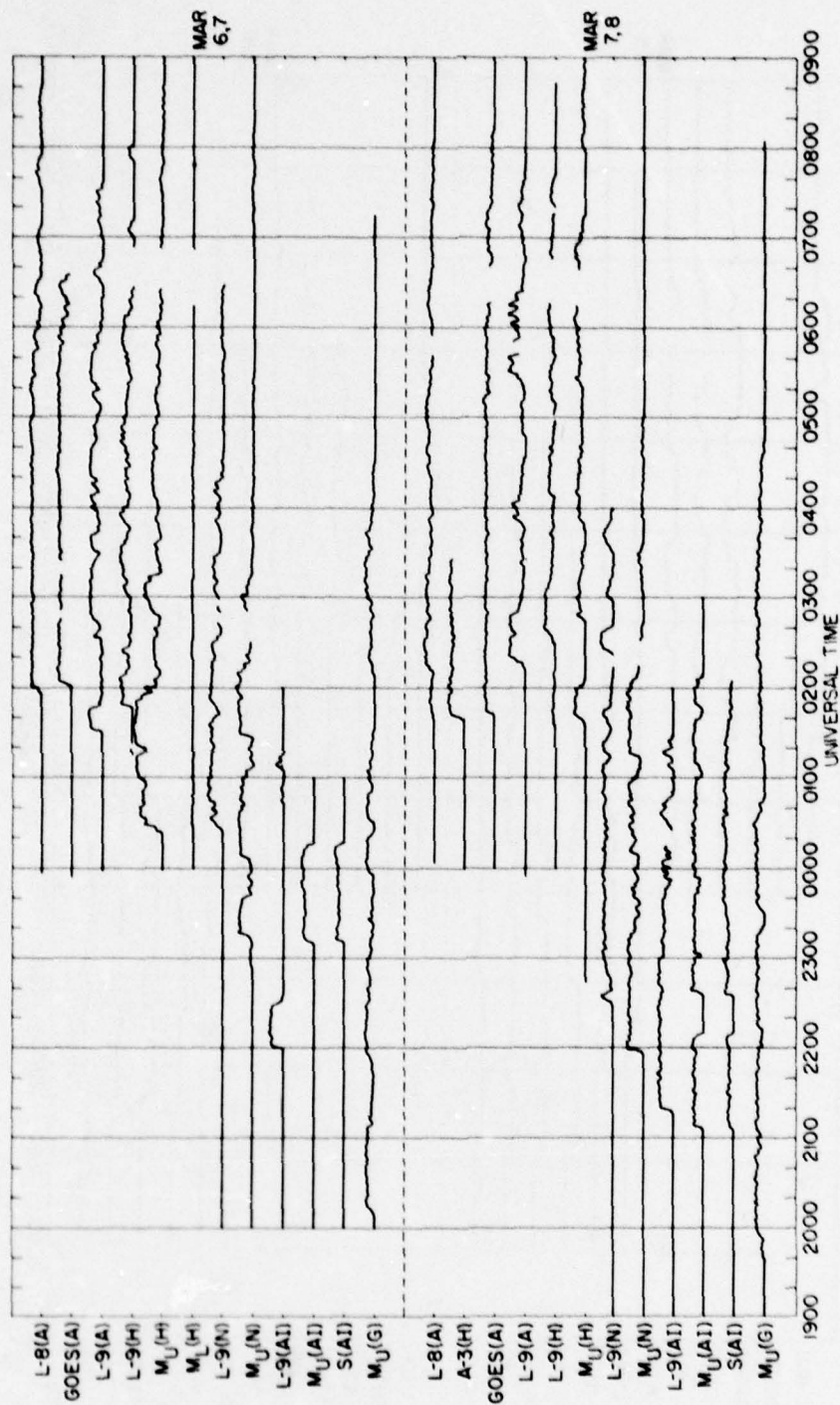


Figure 2d. Summary of Ionospheric Scintillation Occurrence During the March 1978 Test in Peru (Cont.)

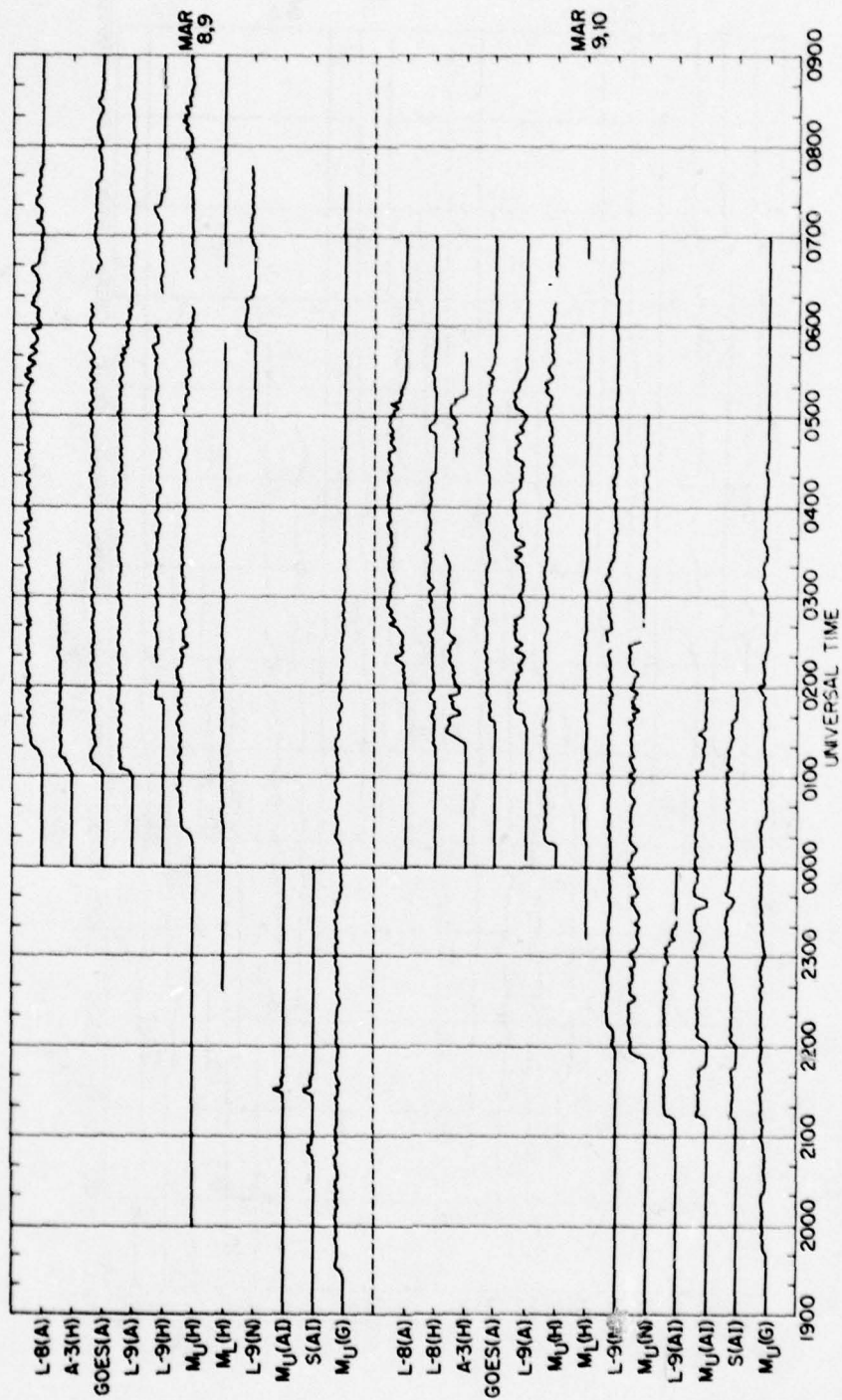


Figure 2e. Summary of Ionospheric Scintillation Occurrence During the March 1978 Test in Peru (Cont.)

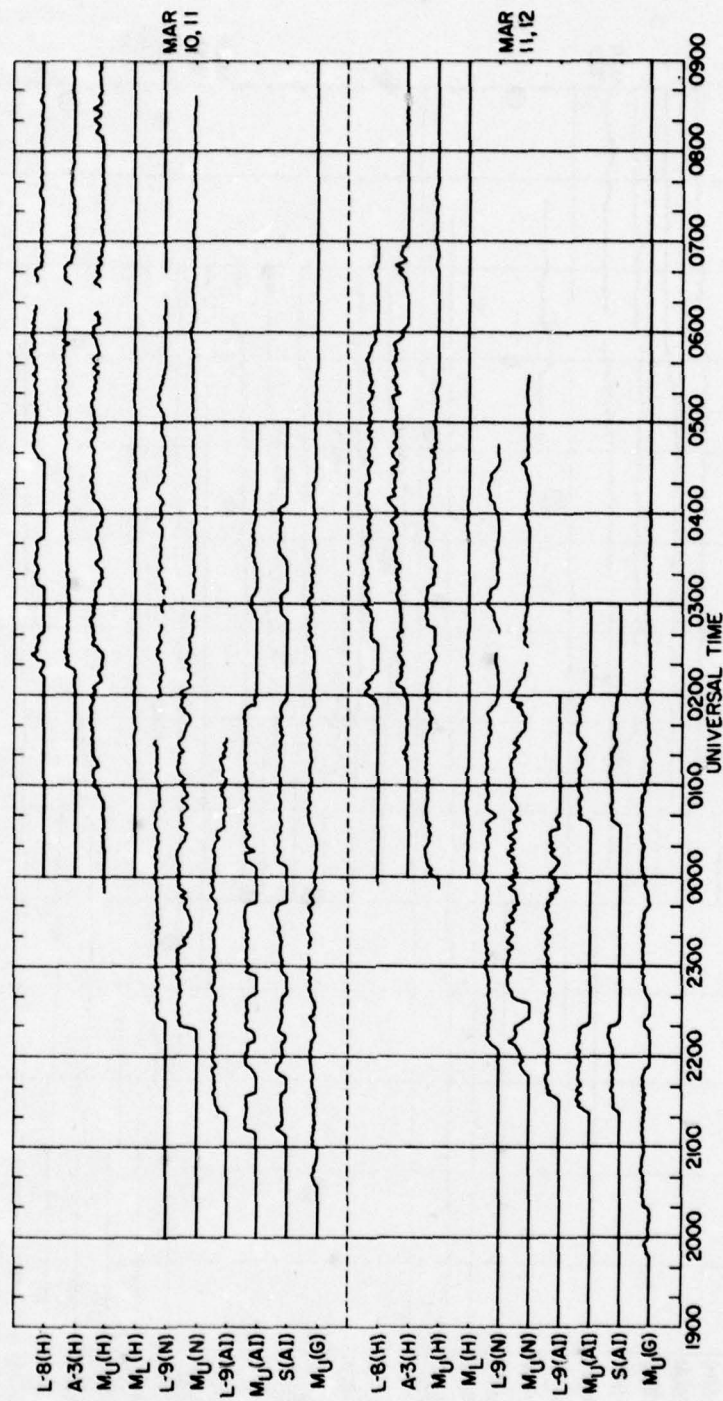


Figure 2f. Summary of Ionospheric Scintillation Occurrence During the March 1978 Test in Peru (Cont.)

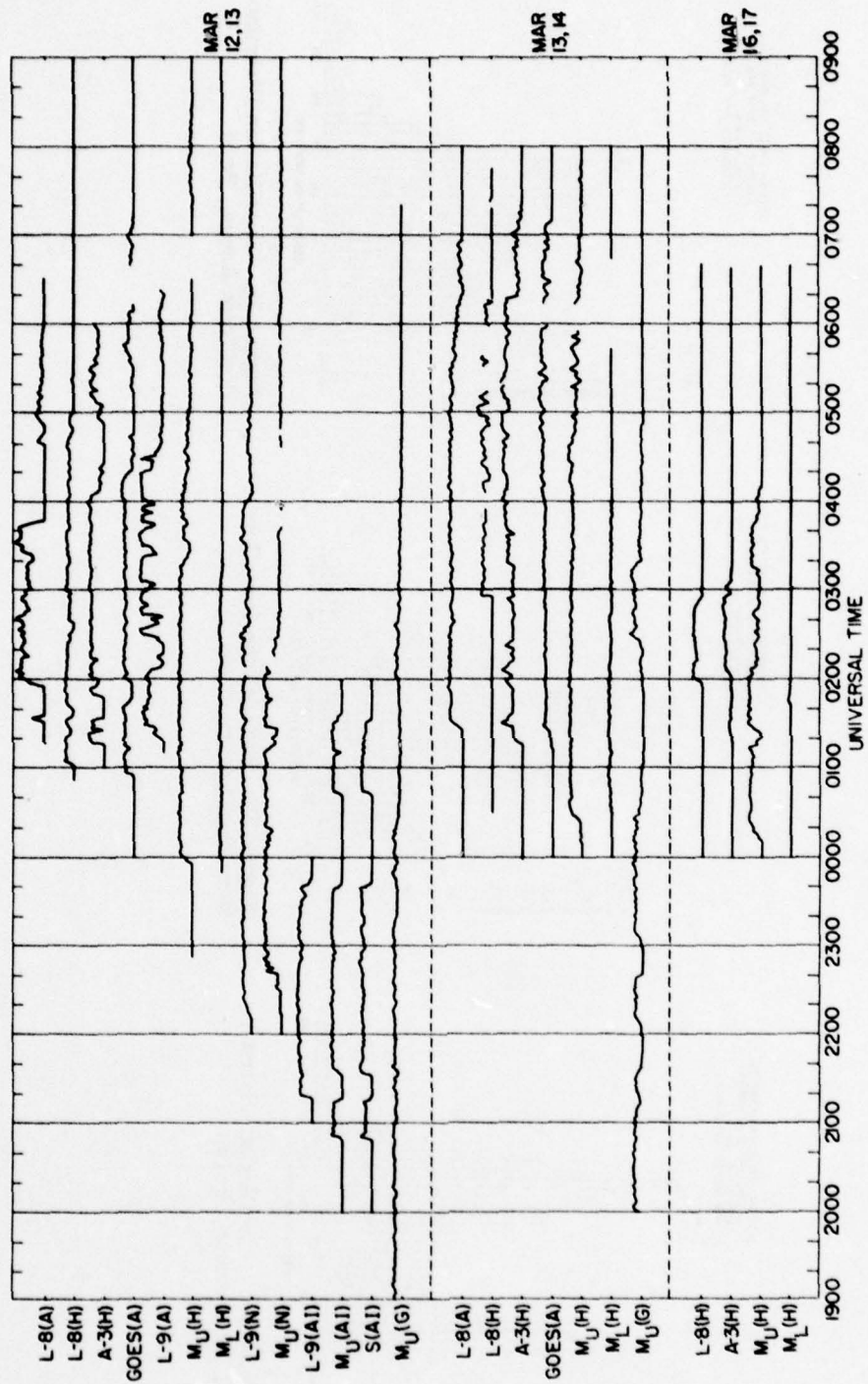


Figure 2g. Summary of Ionospheric Scintillation Occurrence During the March 1978 Test in Peru (Cont.)

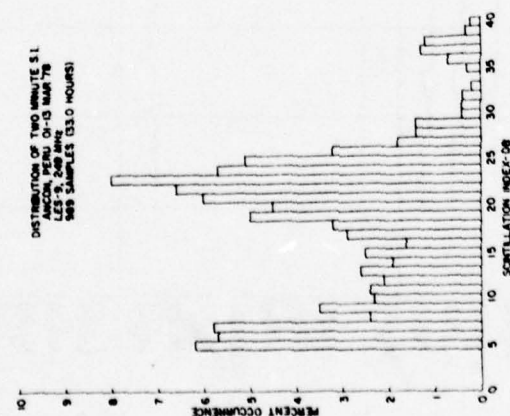


Figure 3a. Scintillation Distribution from Ancon, Peru

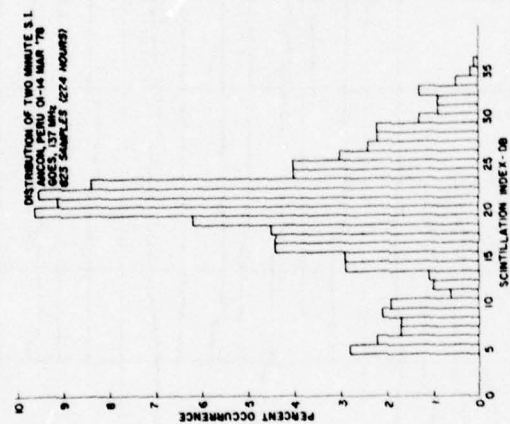


Figure 3b. Scintillation Distribution from Ancon, Peru

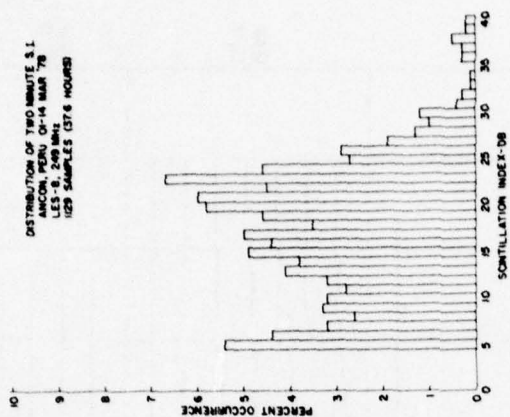


Figure 3c. Scintillation Distribution from Ancon, Peru

DISTRIBUTION OF TWO MINUTE S.I.
 HUANCAYO, PERU 4-9 MARCH 1978
 LES - 9 249 MHz
 574 SAMPLES

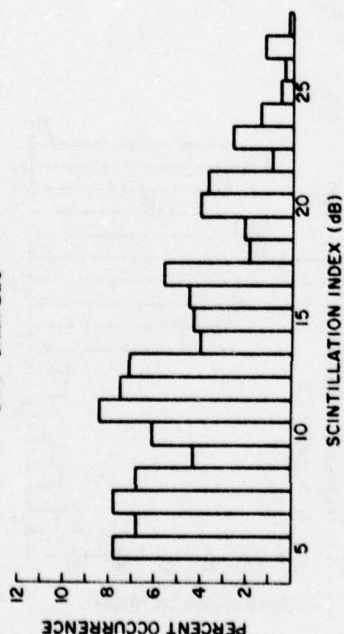


Figure 4a. Scintillation Distribution From Huancayo, Peru

DISTRIBUTION OF TWO MINUTE S.I.
 HUANCAYO, PERU 1-16 MARCH 1978
 MARISAT 257 MHz
 2027 SAMPLES

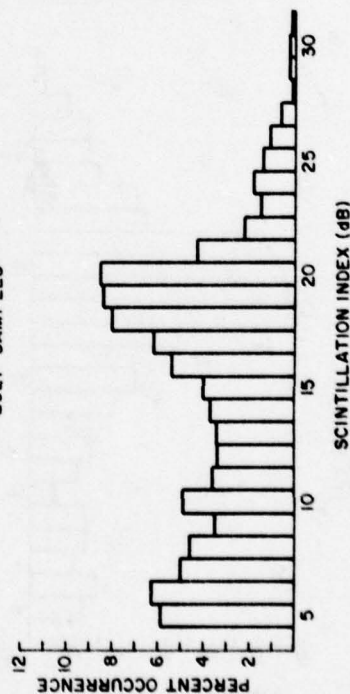


Figure 4b. Scintillation Distribution from Huancayo, Peru

DISTRIBUTION OF TWO MINUTE S.I.
 NATAL, BRAZIL 2-13 MARCH 1978
 LES - 9 249 MHz
 1314 SAMPLES

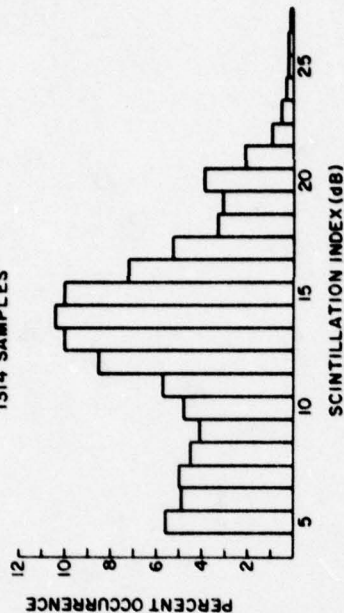


Figure 4c. Scintillation Distribution from Natal, Brazil

DISTRIBUTION OF TWO MINUTE S.I.
 NATAL, BRAZIL 3-13 MARCH 1978
 MARISAT 257 MHz
 1211 SAMPLES

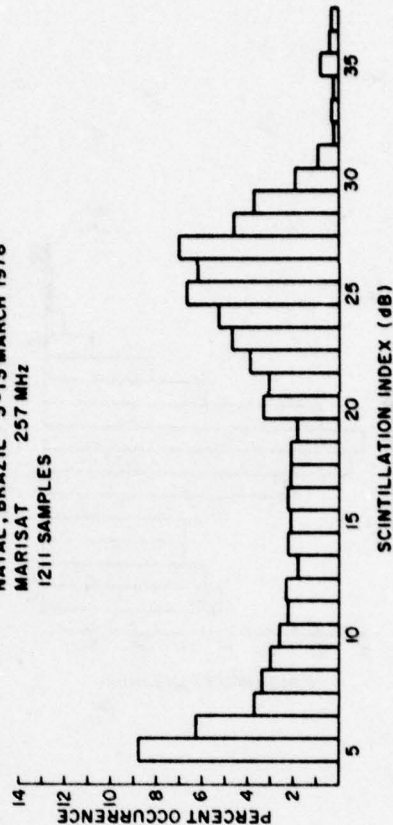


Figure 4d. Scintillation Distribution from Natal, Brazil

DISTRIBUTION OF TWO MINUTE S.I.
ASCENSION ISLAND 2-12 MARCH 1978
LES - 9 249 MHz
754 SAMPLES

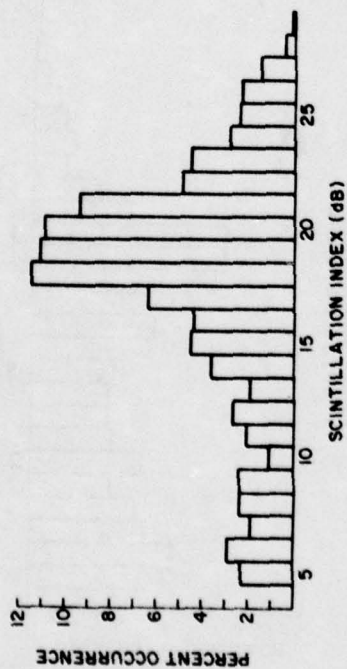


Figure 5a. Scintillation Distribution from Ascension Island

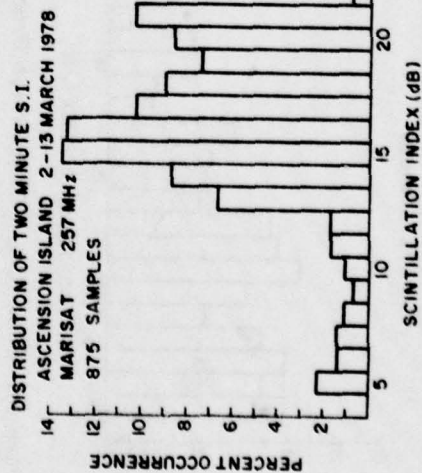


Figure 5b. Scintillation Distribution from Ascension Island

DISTRIBUTION OF TWO MINUTE S.I.
ACCRA, GHANA 2-14 MARCH 1978
MARISAT 257 MHz
1989 SAMPLES

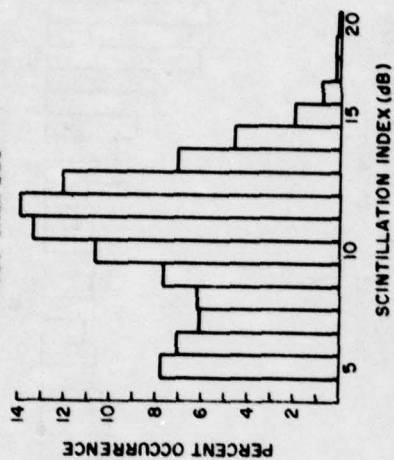


Figure 5c. Scintillation Distribution from Accra, Ghana

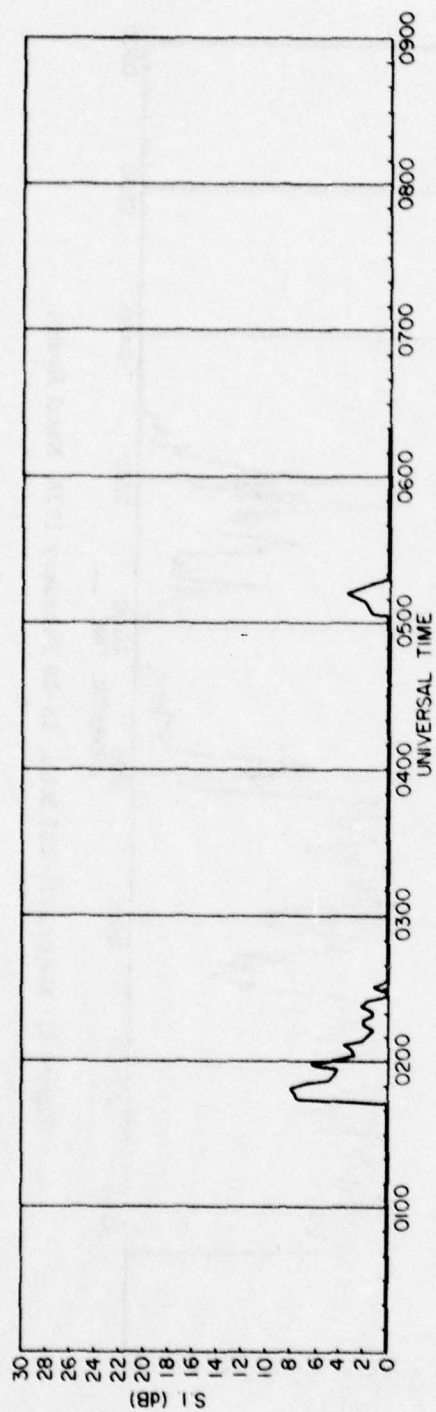


Figure 6. MARISAT, 257 MHz, 24 January 1978, Natal, Brazil

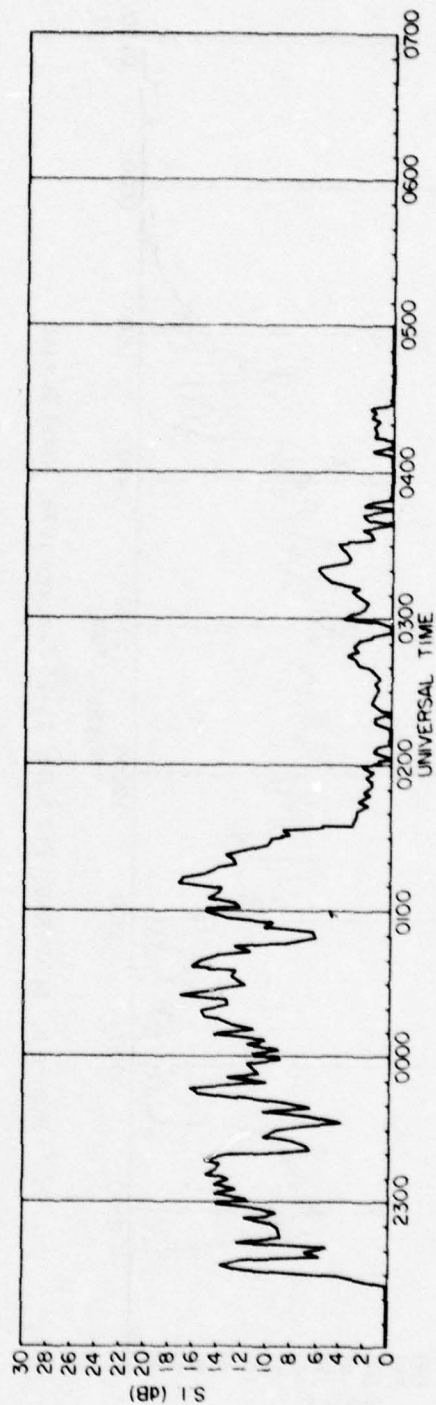


Figure 7. MARISAT, 257 MHz, 24-25 January 1978, Natal, Brazil

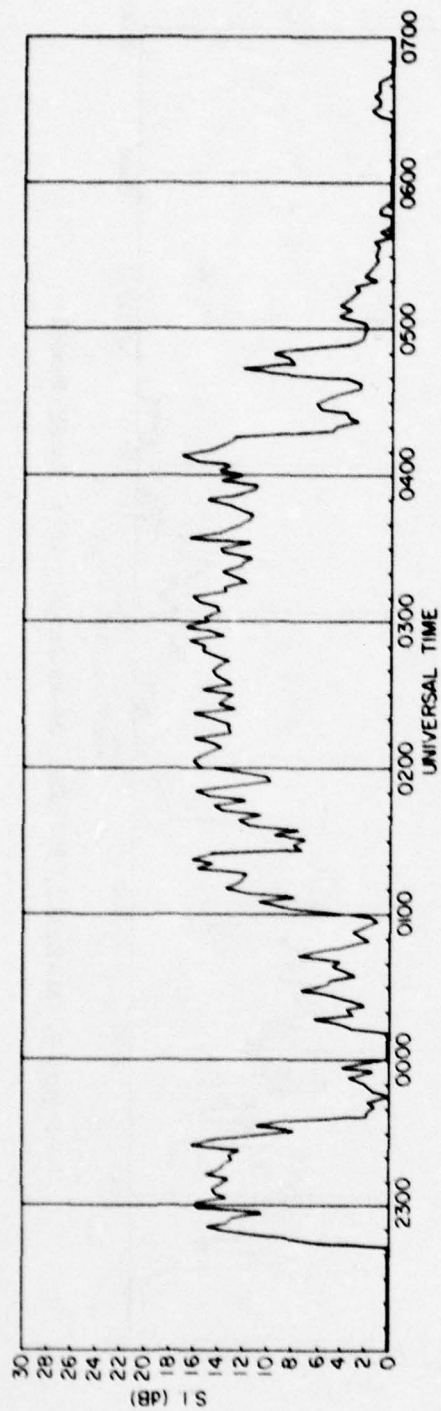


Figure 8. MARISAT, 257 MHz, 25-26 January 1978, Natal Brazil

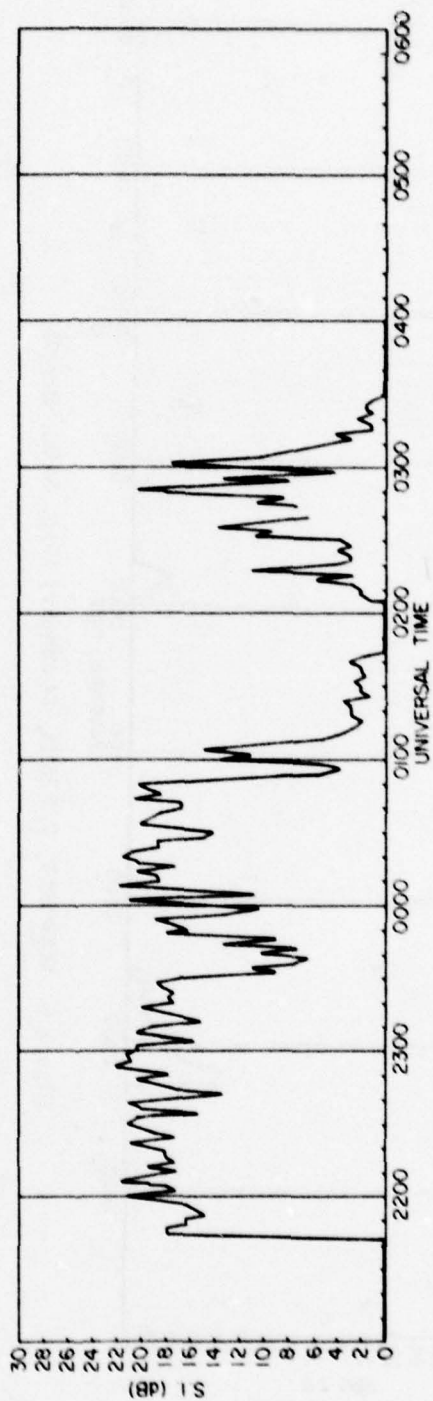


Figure 9. MARISAT, 257 MHz, 25-26 February 1978, Natal Brazil

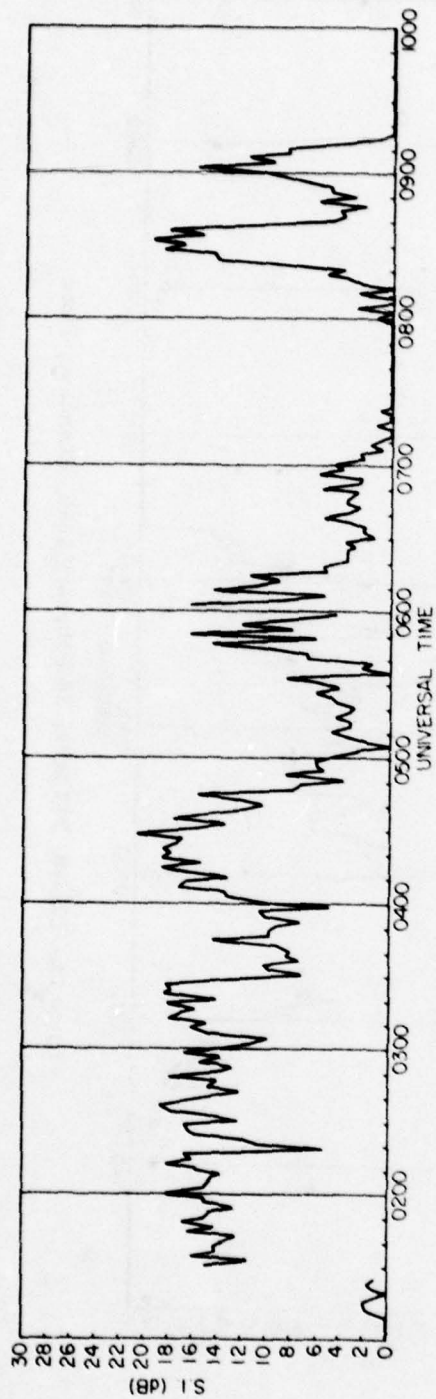


Figure 10. MARISAT, 257 MHz, 26 February 1978, Huancayo, Peru

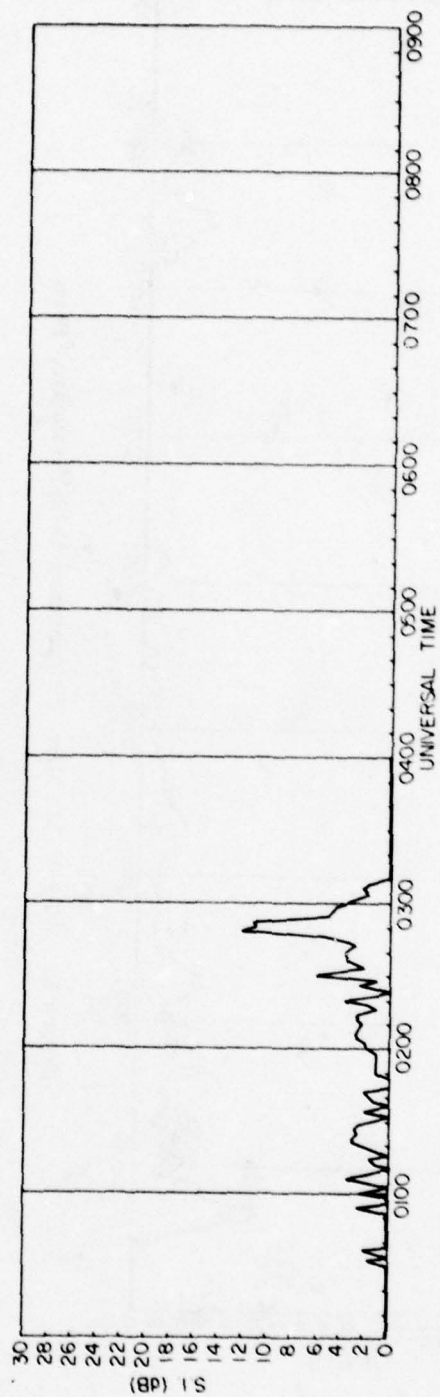


Figure 11. GOES, 137 MHz, 26 February 1978, Huancayo, Peru

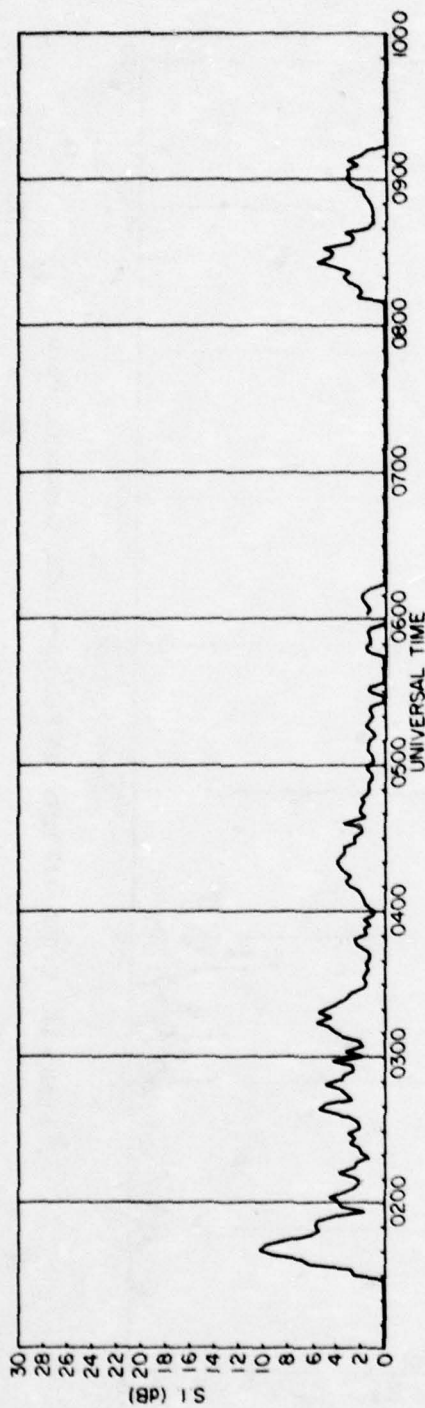


Figure 12. ATS-3, 136 MHz, 26 February 1978, Hyancayo, Peru

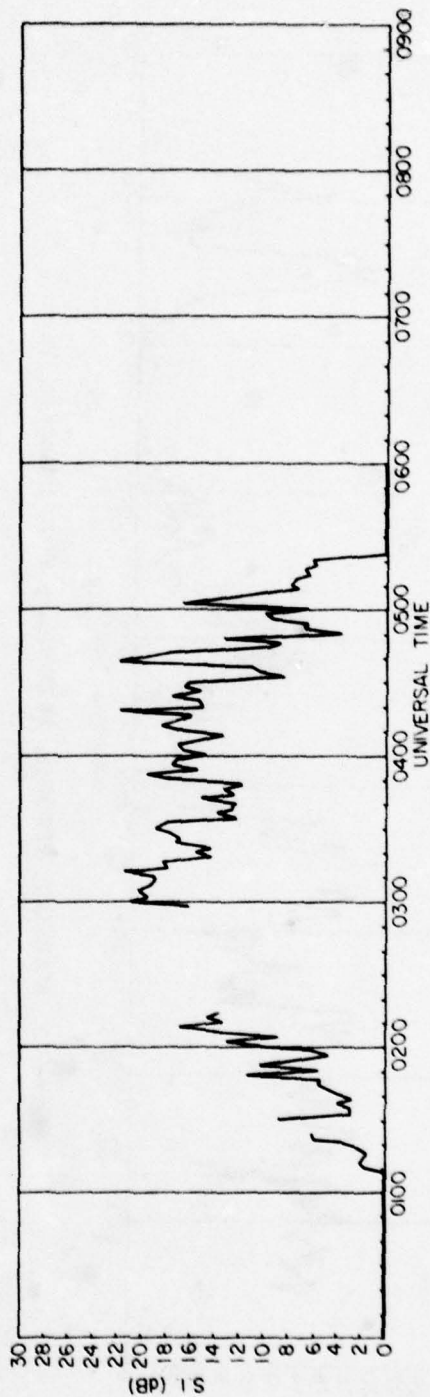


Figure 13. LES-8, 249 MHz, 26 February 1978, Huancayo, Peru

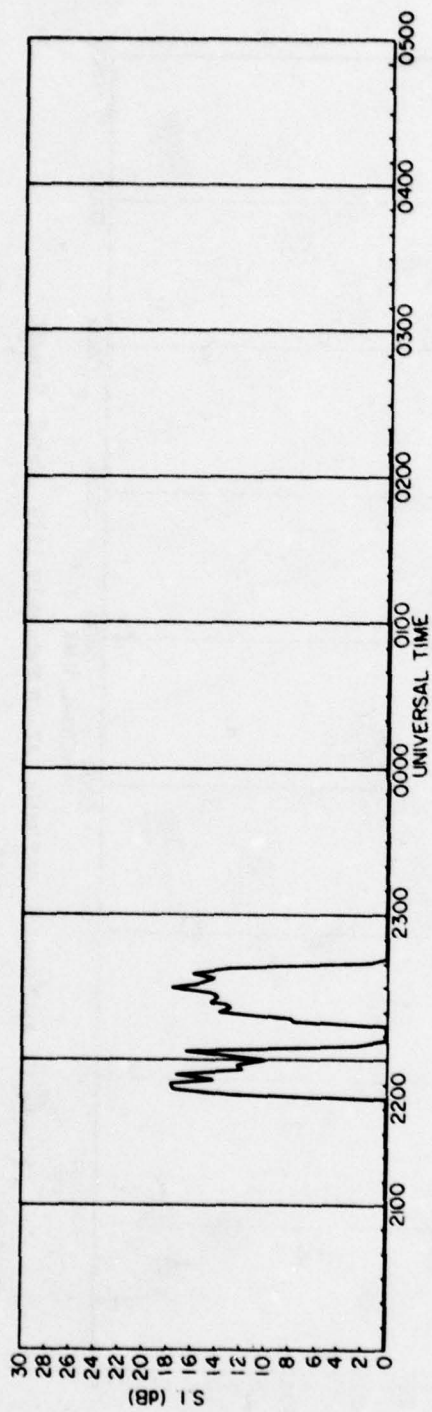


Figure 14. SIRIO, 136 MHz, 26-27 February 1978, Ascension Island

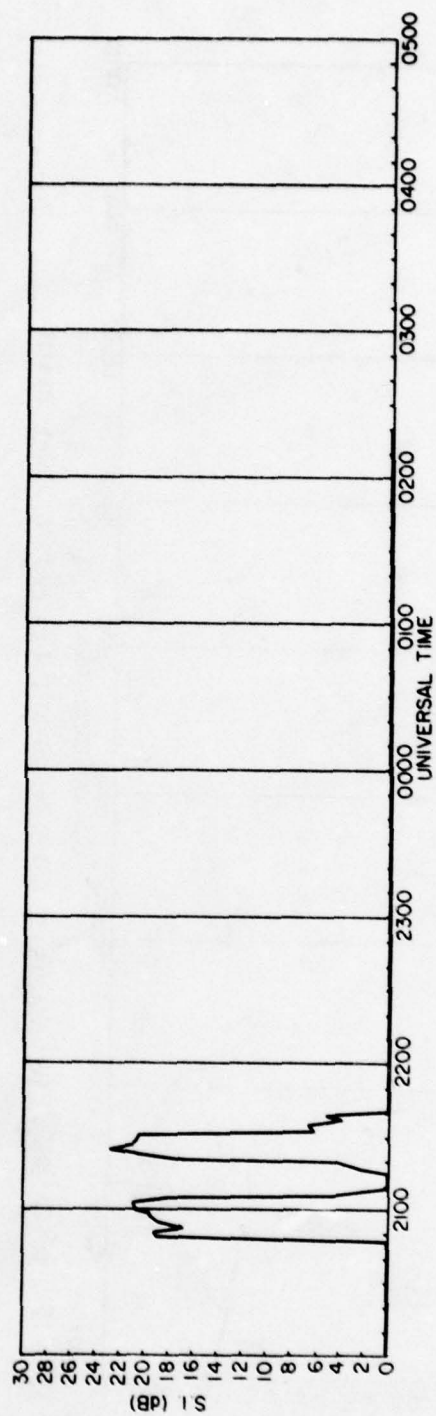


Figure 15. MARISAT, 257 MHz, 26-27 February 1978, Ascension Island

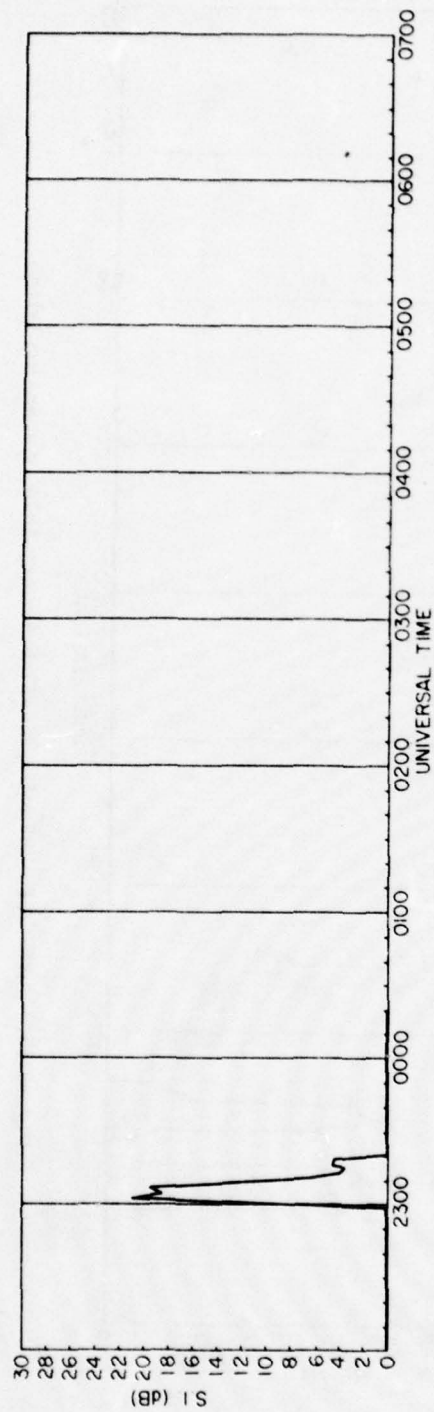


Figure 16. MARISAT, 257 MHz, 26-27 February 1978, Natal, Brazil

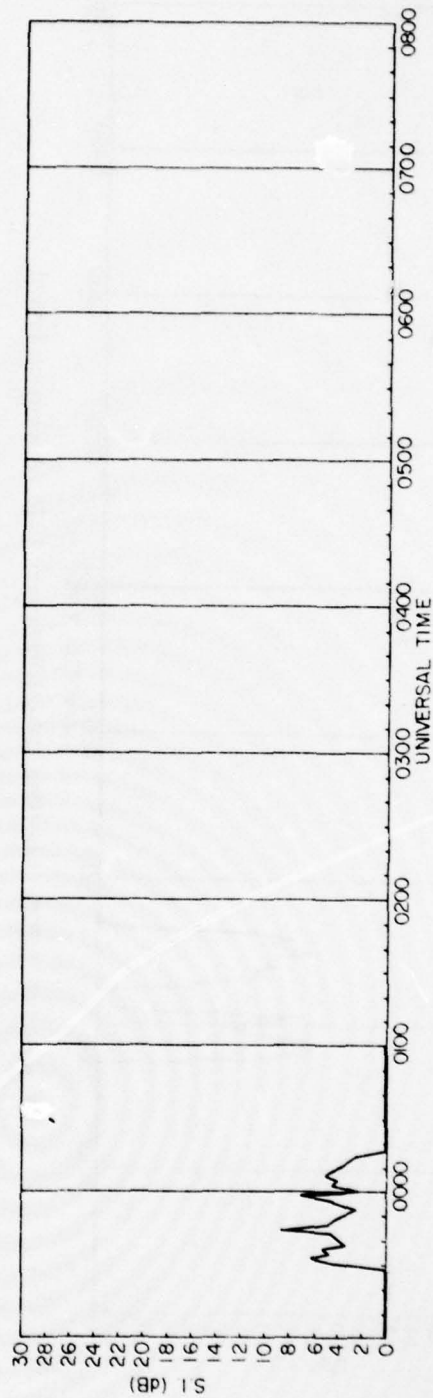


Figure 17. MARISAT, 257 MHz, 27-28 February 1978, Natal, Brazil

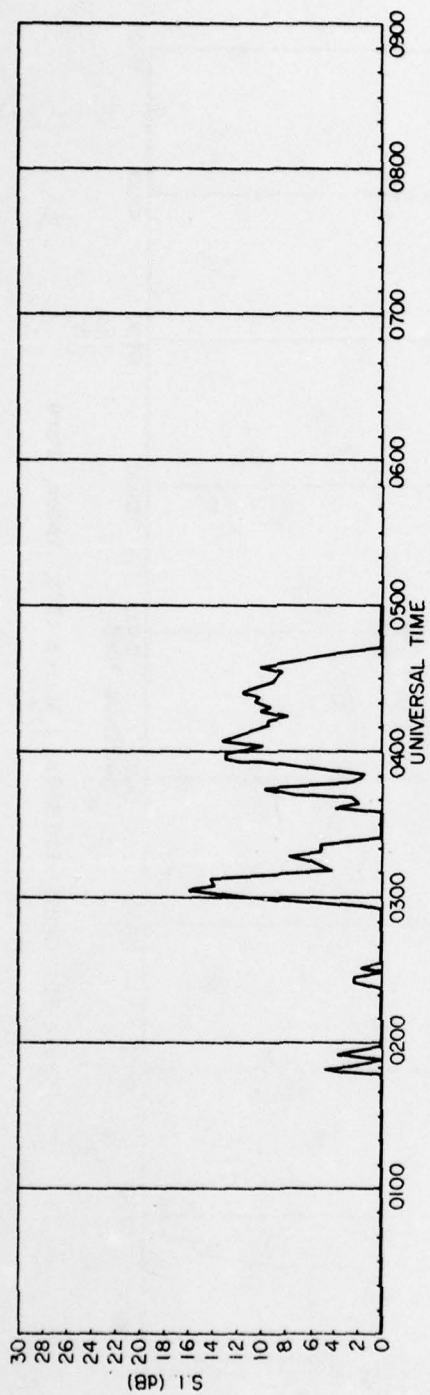


Figure 18. MARISAT, 257 MHz, 1 March 1978, Huancayo, Peru

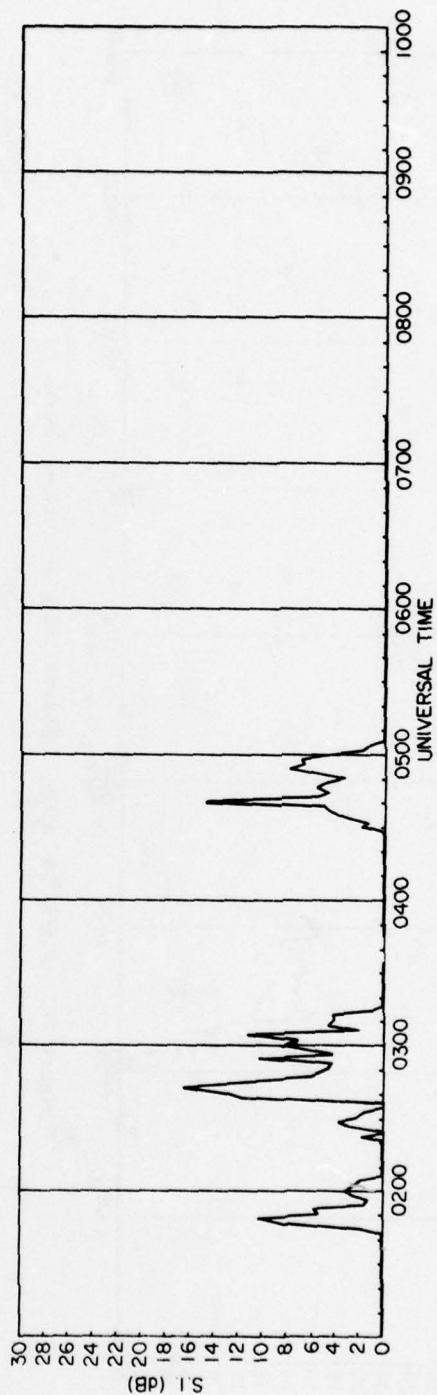


Figure 19. LES-9, 249 MHz, 1 March 1978, Ancon, Peru

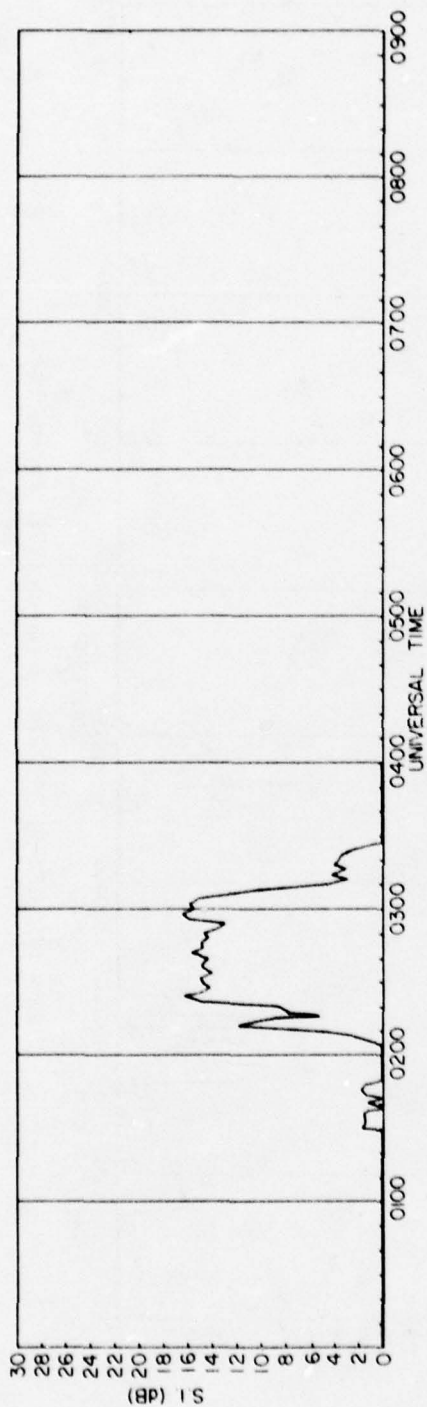


Figure 20. GOES, 136 MHz, 1 March 1978, Huancayo, Peru

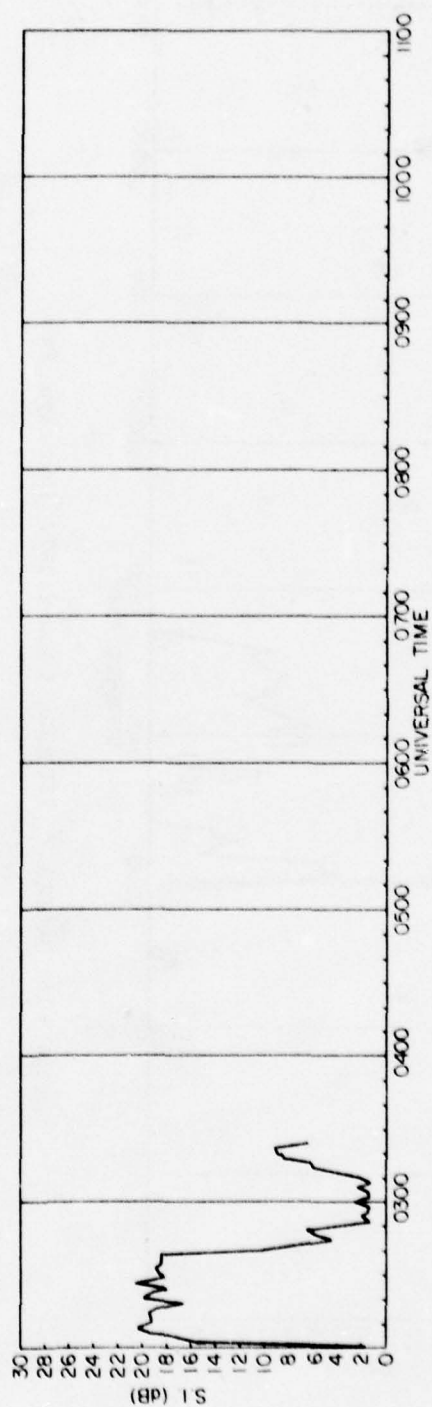


Figure 21. GOES, 136 MHz, 1 March 1978, Ancon, Peru

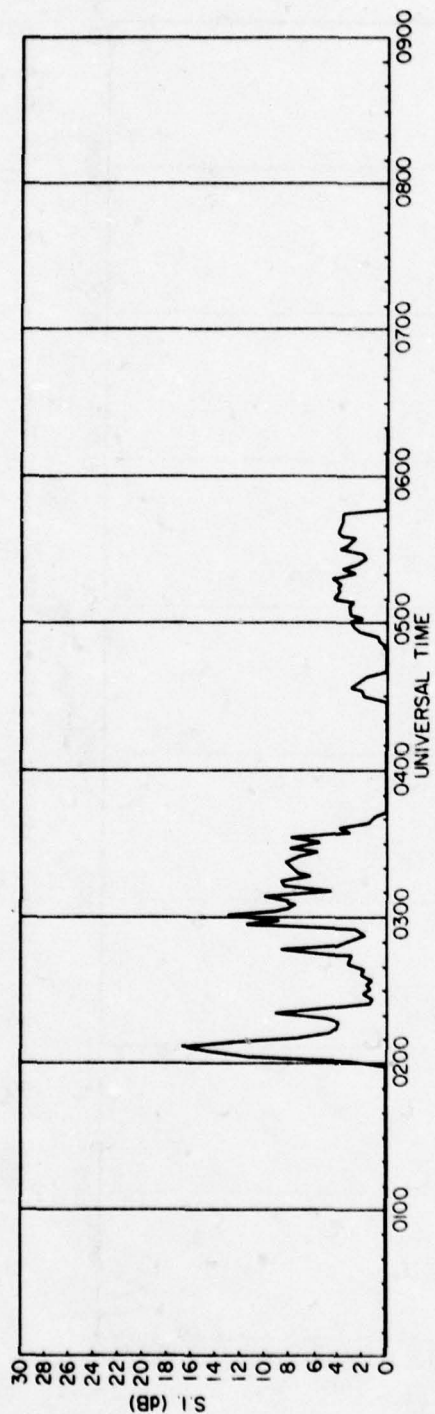


Figure 22. LES-8, 249 MHz, 1 March 1978, Huancayo, Peru

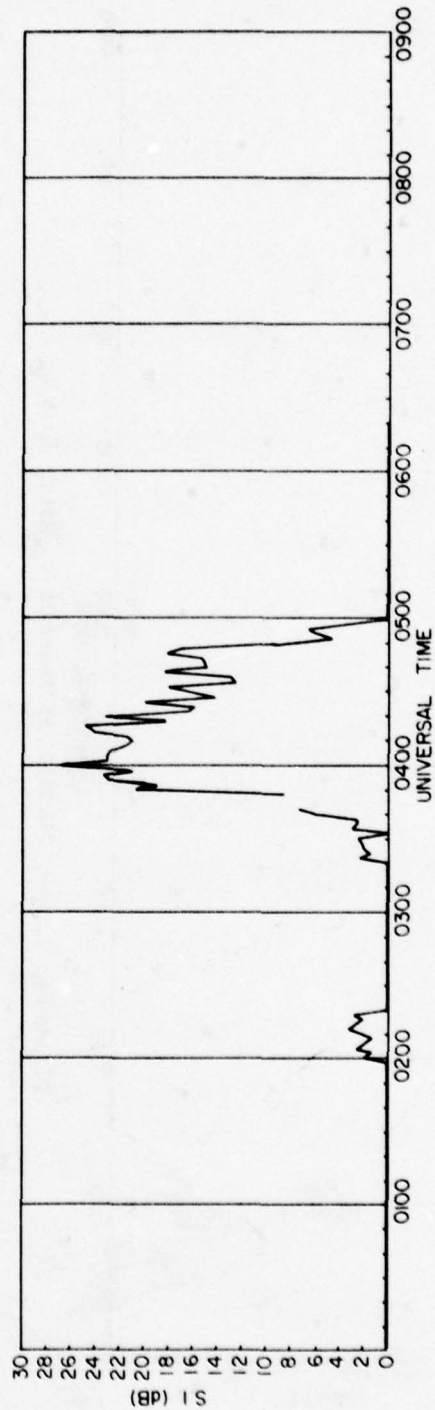


Figure 23. LES-8, 249 MHz, 1 March 1978, Ancon, Peru

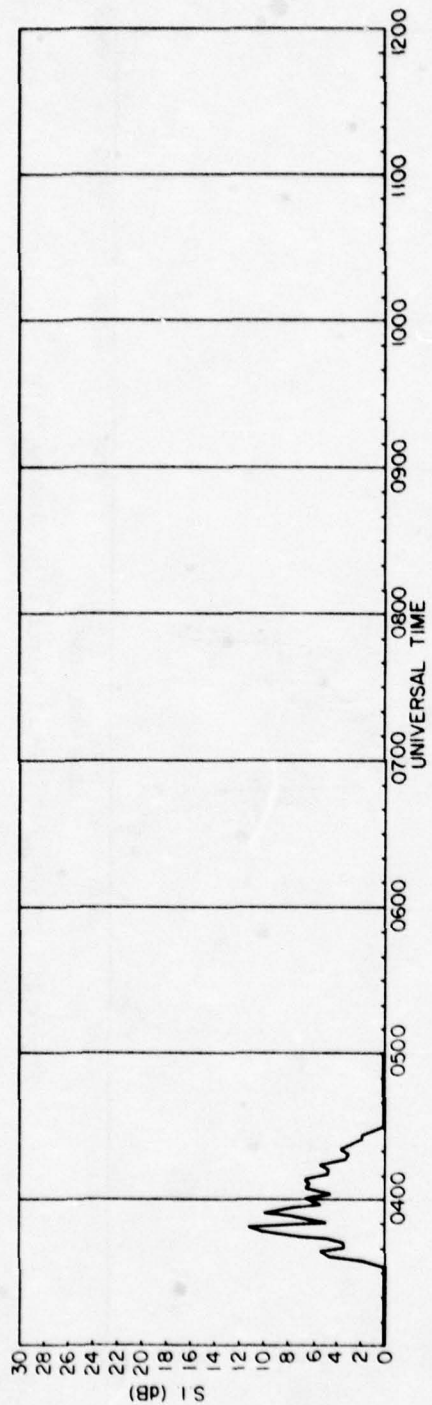


Figure 24. LES-9, 249 MHz, 2 March 1978, Natal, Brazil

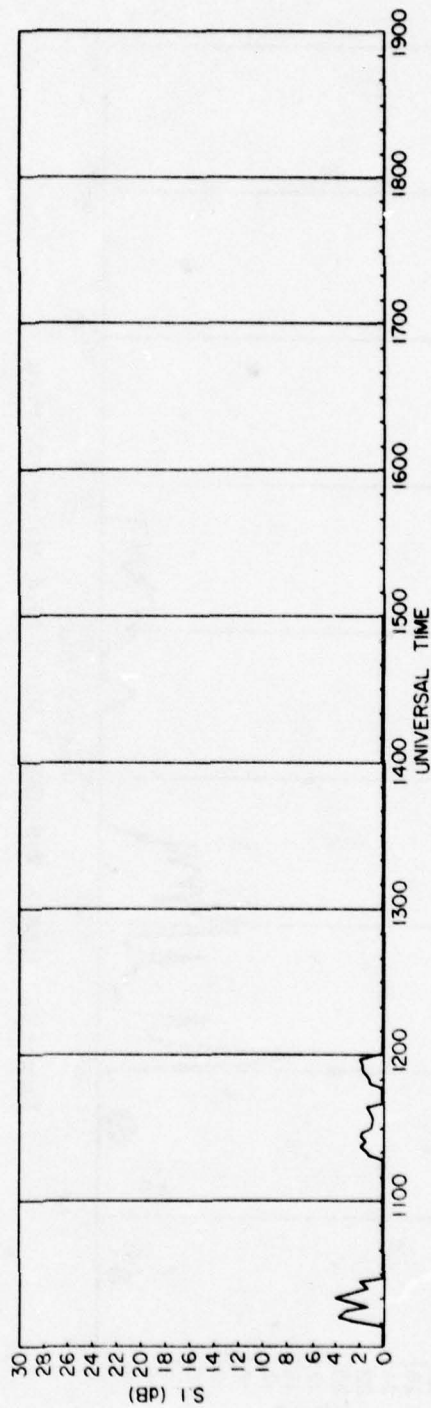


Figure 25. LES-9, 249 MHz, 2 March 1978, Ancon, Peru

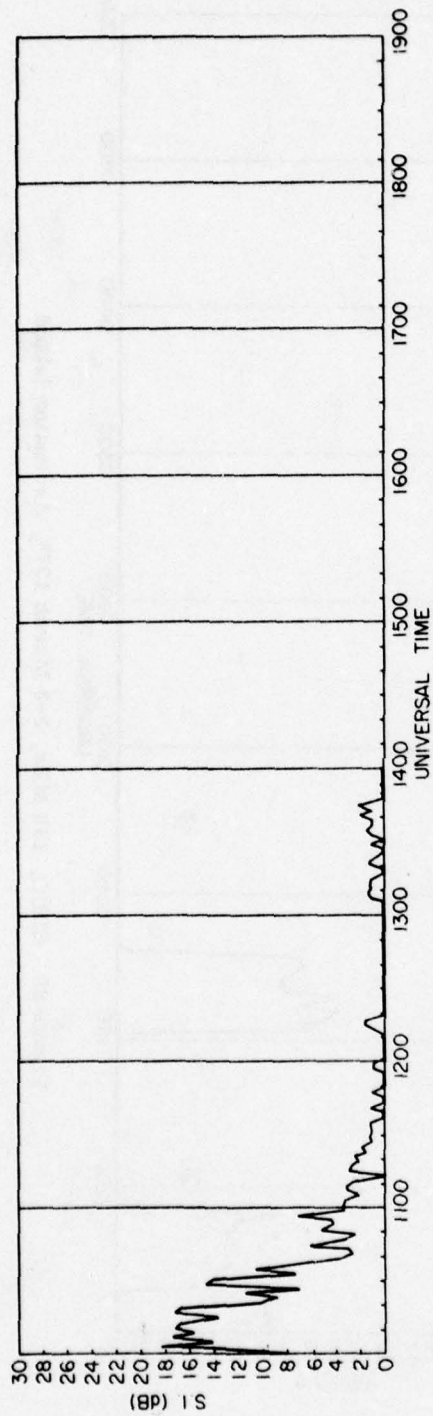


Figure 26. GOES, 136 MHz, 2 March 1978, Ancon, Peru

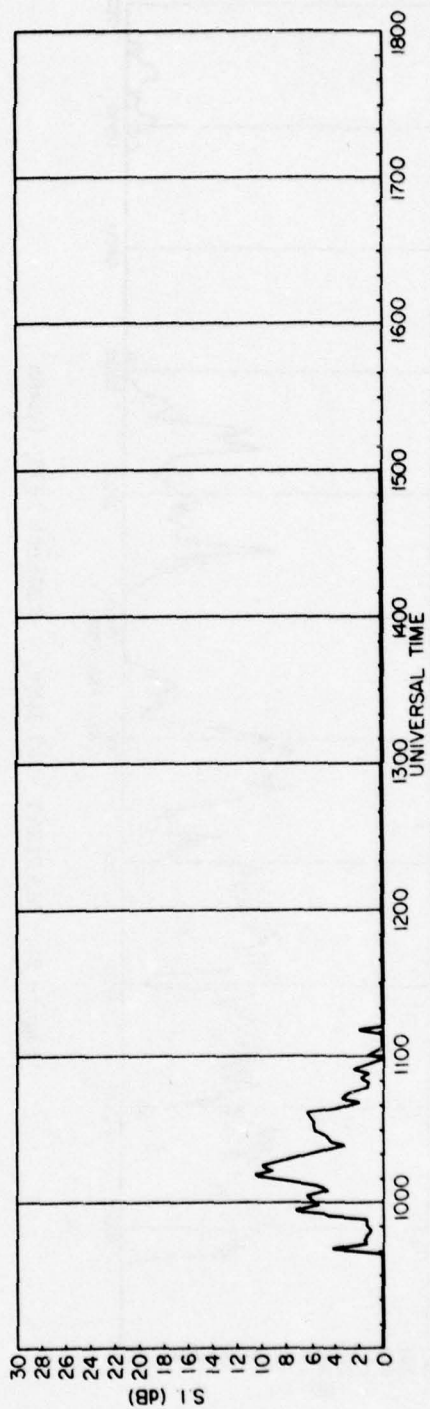


Figure 27. LES-8, 249 MHz, 2 March 1978, Ancon, Peru

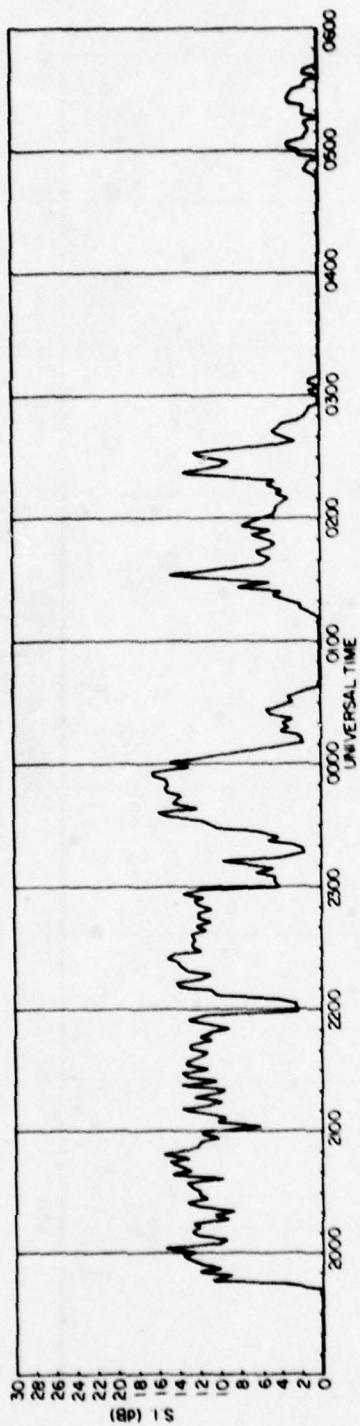


Figure 28. MARISAT, 257 MHz, 2-3 March 1978, Ghana

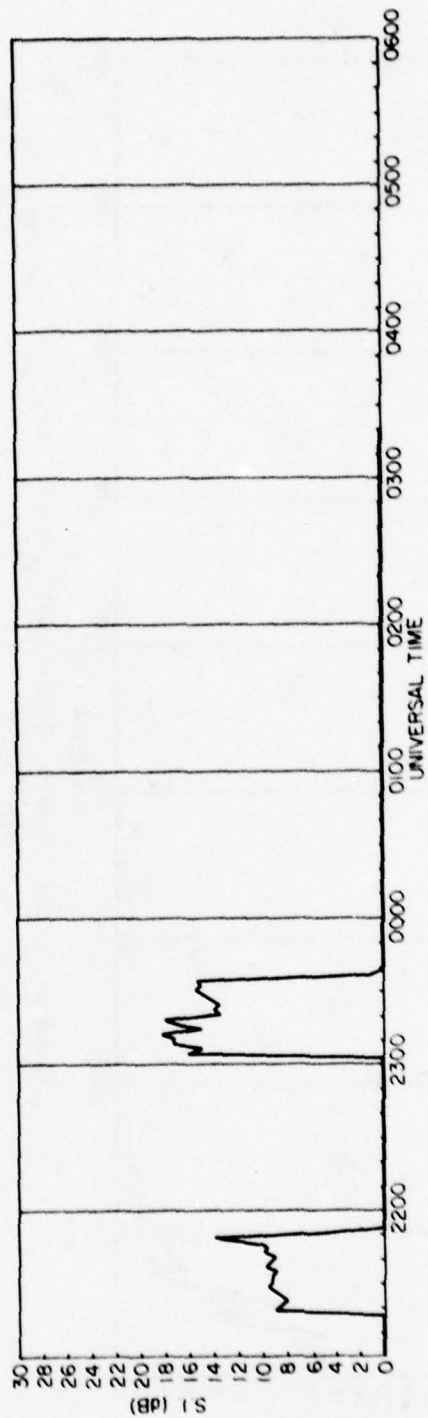


Figure 29. SIRIO, 136 MHz, 2-3 March 1978, Ascension Island

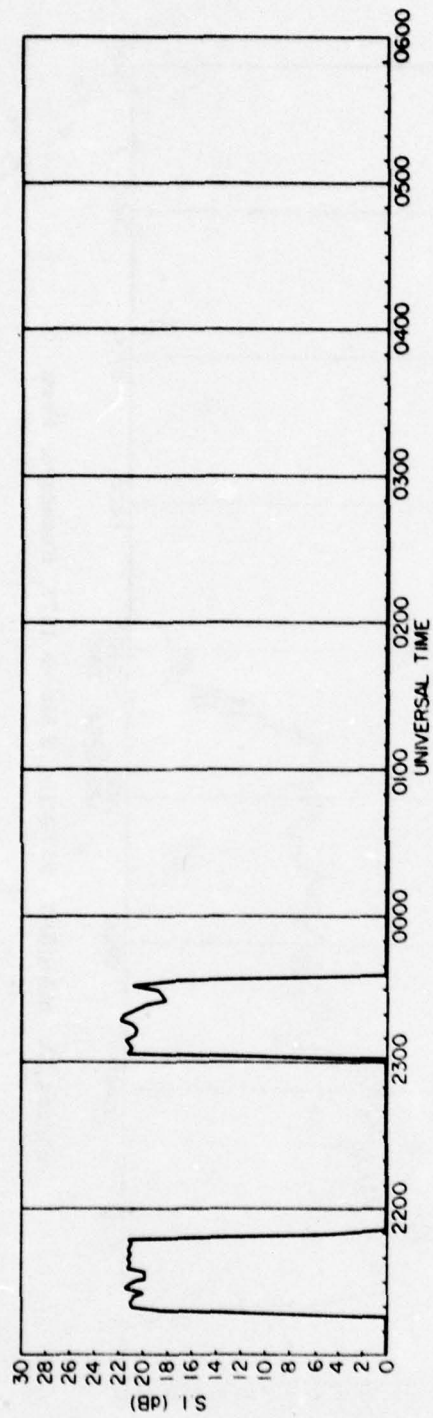


Figure 30. MARISAT, 257 MHz, 2-3 March 1978, Ascension Island

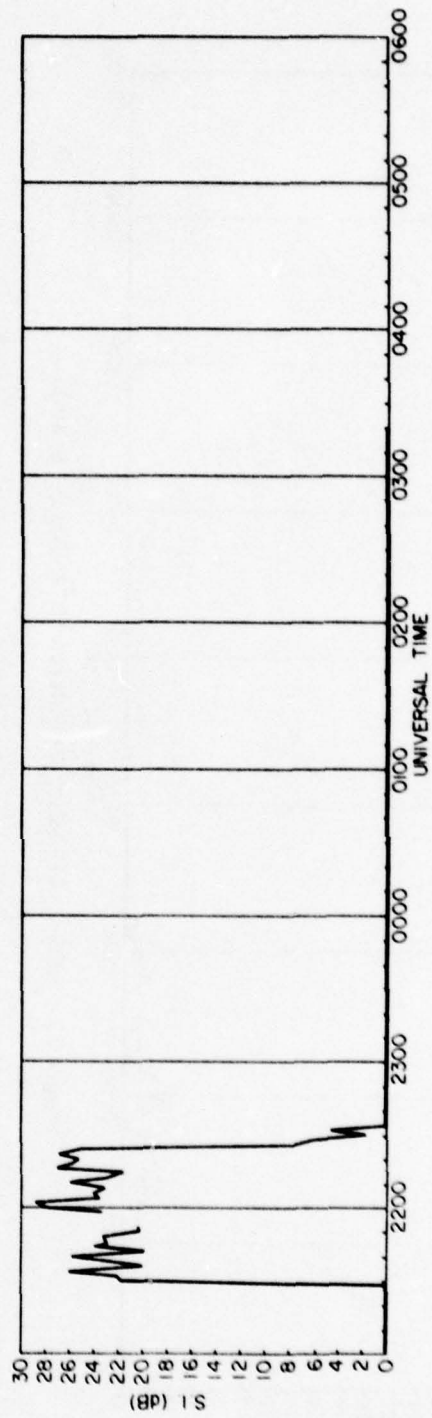


Figure 31. LES-9, 249 MHz, 2-3 March 1978, Ascension Island

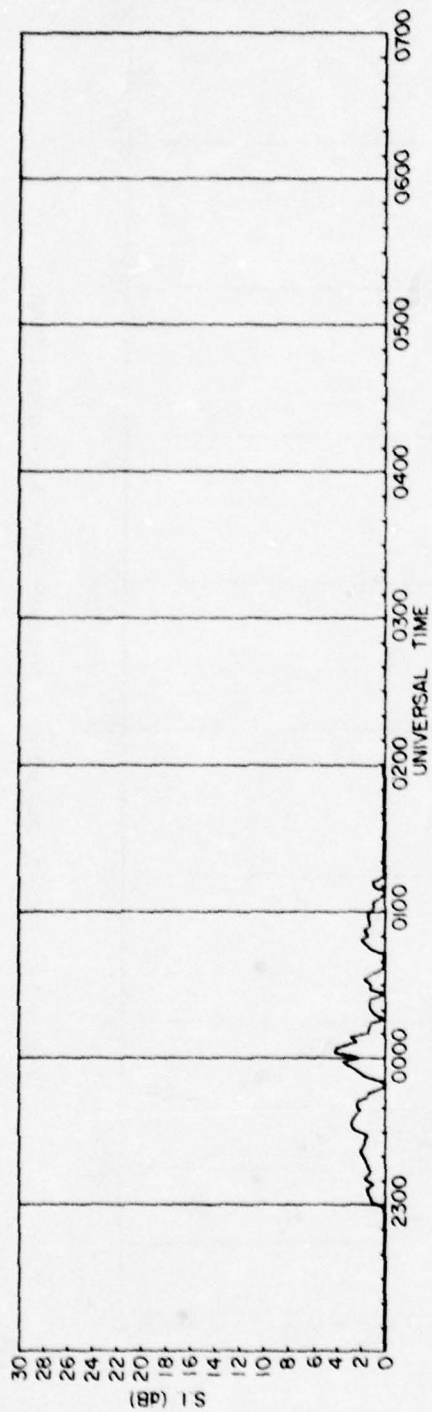


Figure 32. LES-9, 249 MHz, 2-3 March 1978, Natal, Brazil

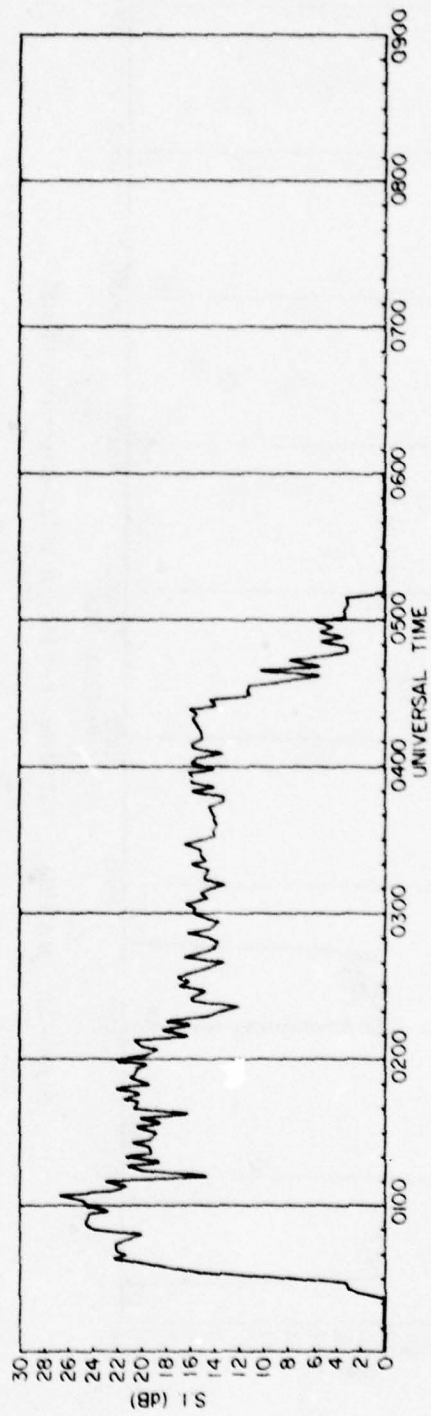


Figure 33. MARISAT, 257 MHz, 3 March 1978, Huancayo, Peru

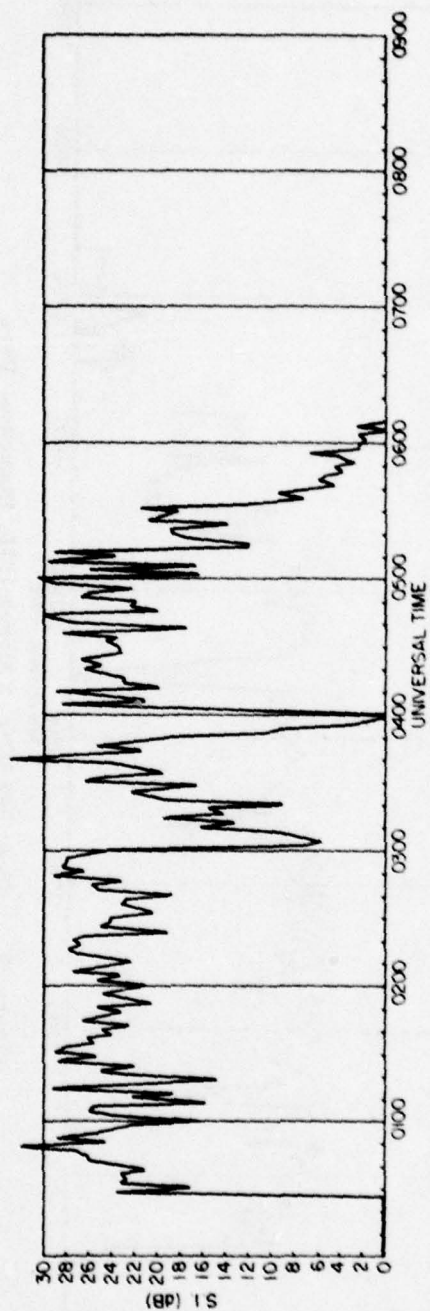


Figure 34. LES-9, 249 MHz, 3 March 1978, Ancon, Peru

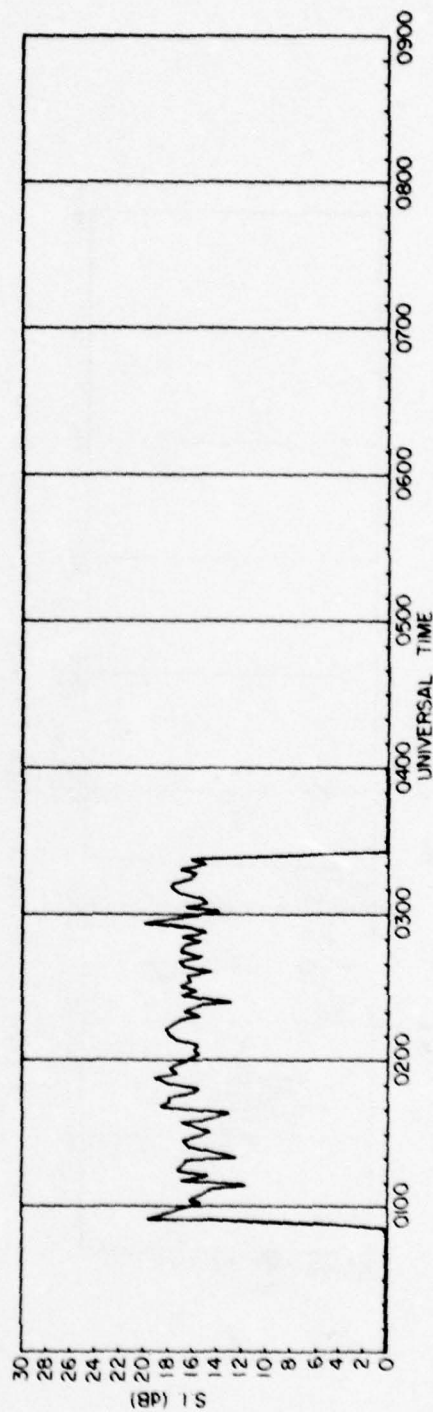


Figure 35. GOES, 136 MHz, 3 March 1978, Huancayo, Peru

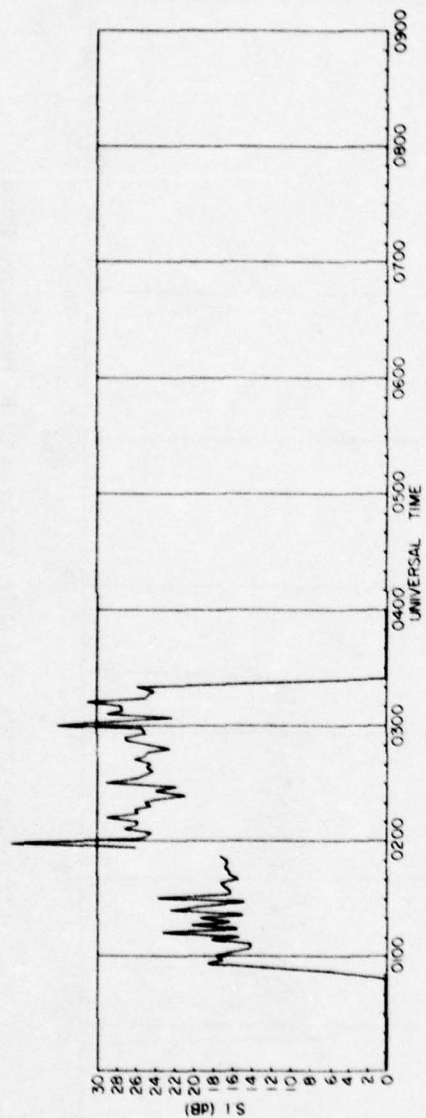


Figure 36. GOES, 136 MHz, 3 March 1978, Ancon, Peru

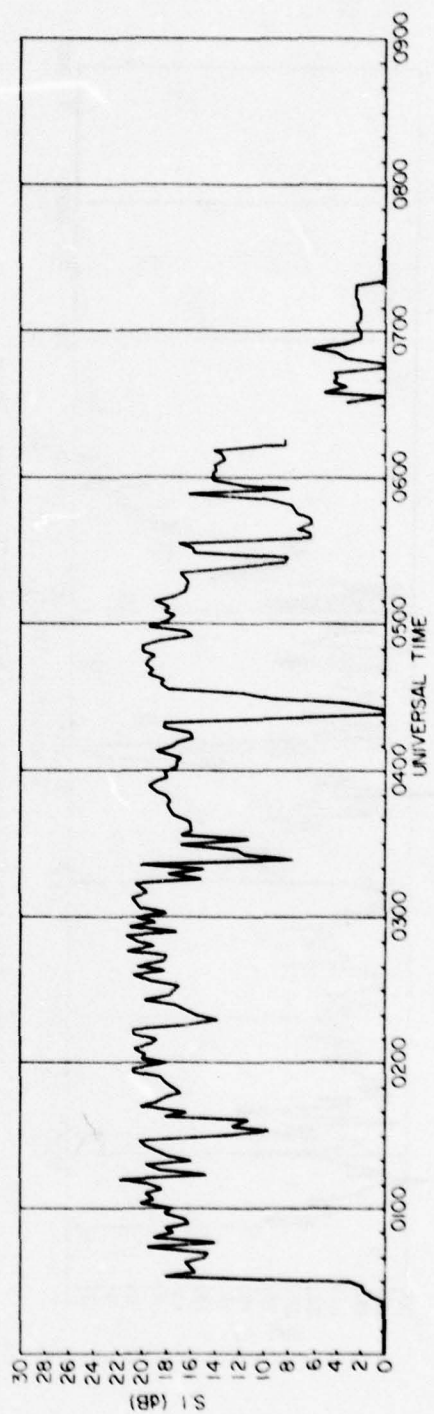


Figure 37. LES-8, 249 MHz, 3 March 1978, Huancayo, Peru

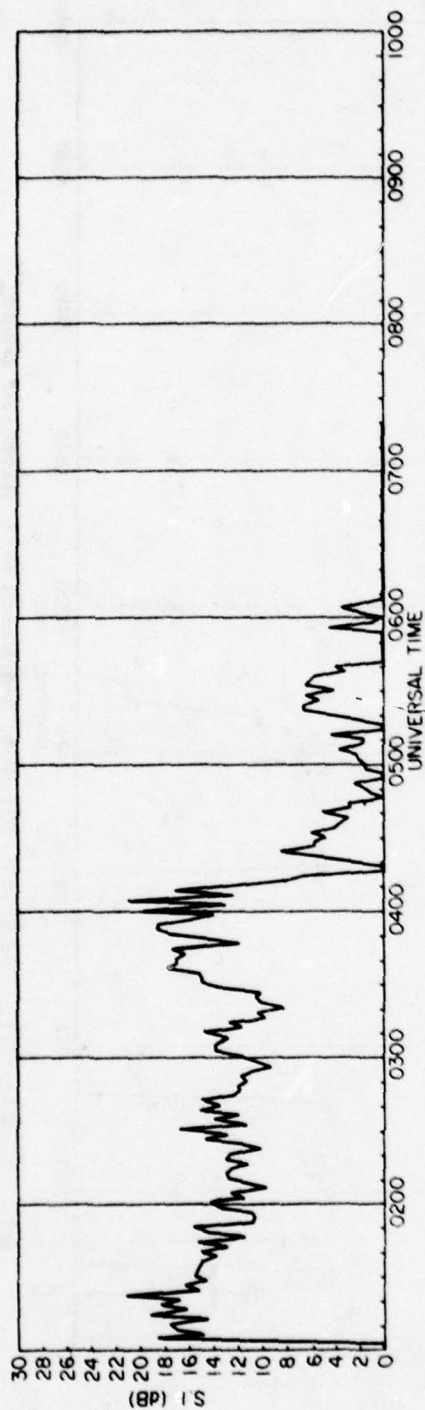


Figure 38. LES-8, 249 MHz, 3 March 1978, Ancon, Peru

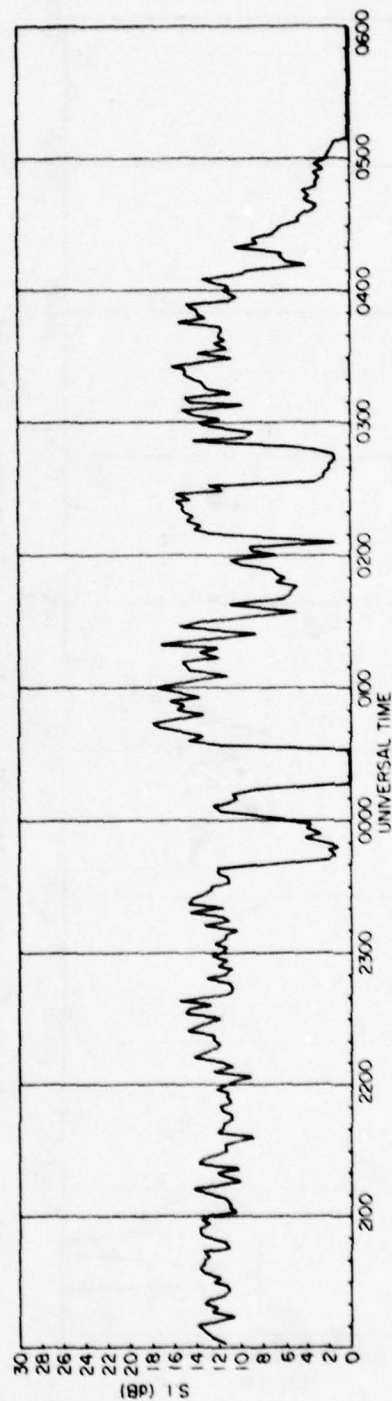


Figure 39. MARISAT, 257 MHz, 3-4 March 1978, Ghana

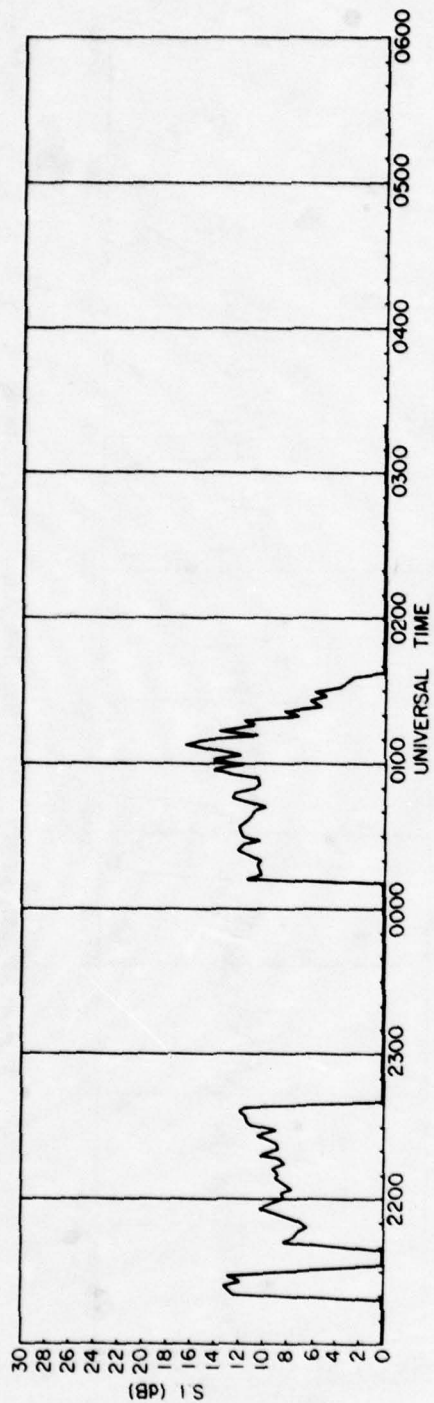


Figure 40. SIRIO, 136 MHz, 3-4 March 1978, Ascension Island

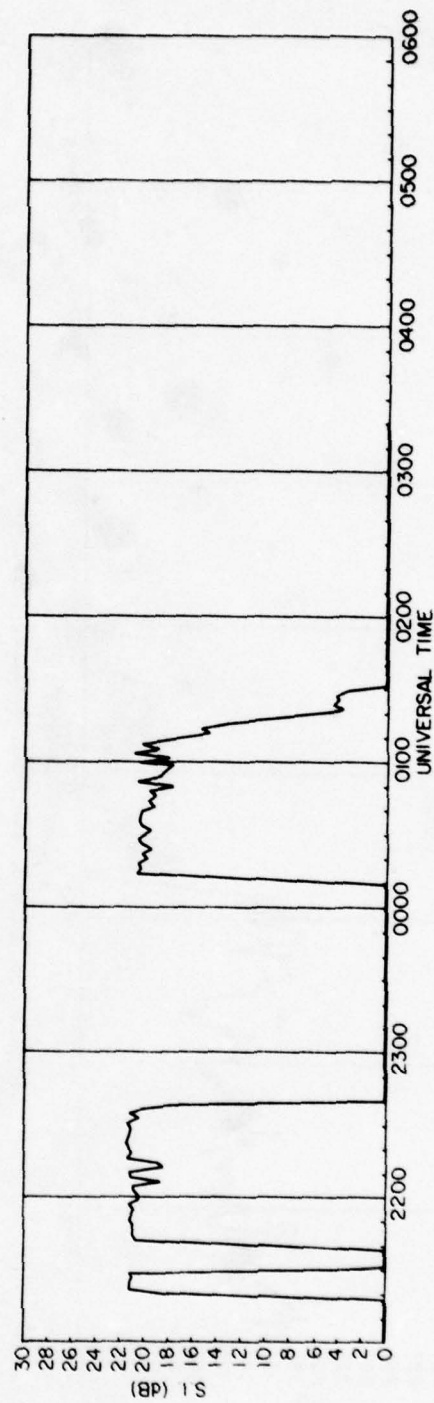


Figure 41. MARISAT, 257 MHz, 3-4 March 1978, Ascension Island

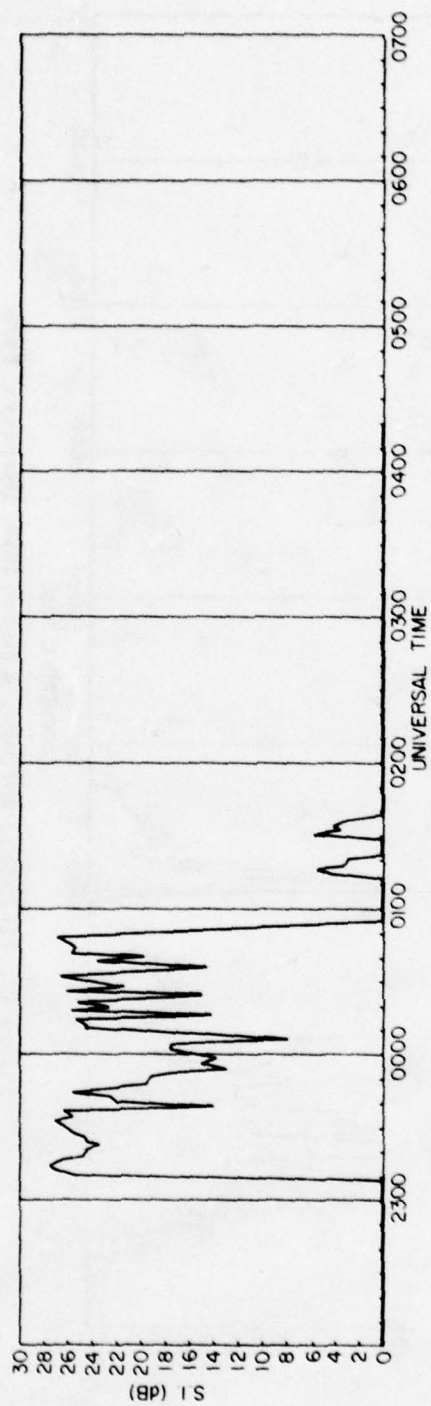


Figure 42. LES-9, 249 MHz, 3-4 March 1978, Ascension Island

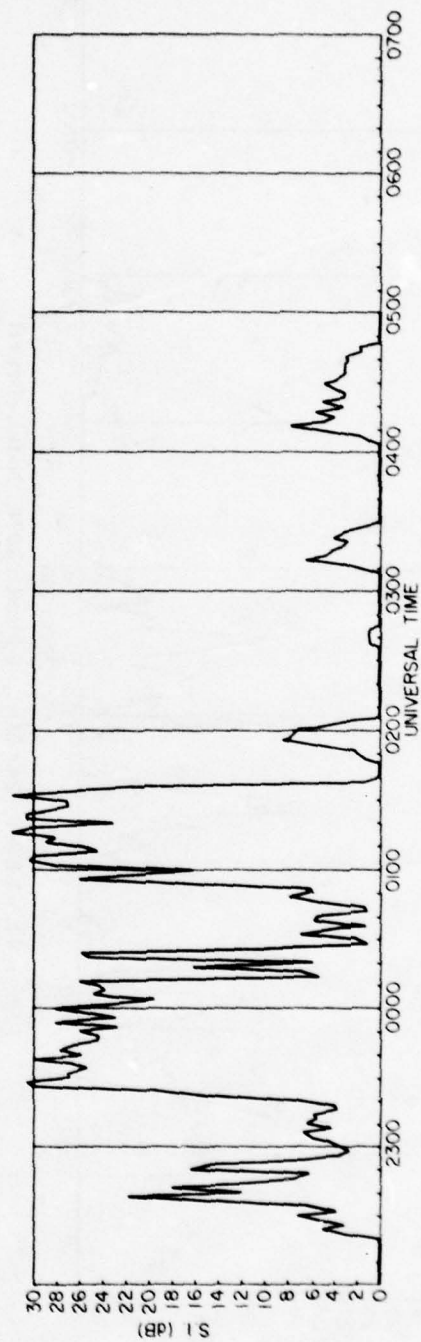


Figure 43. MARISAT, 257 MHz, 3-4 March 1978, Natal, Brazil

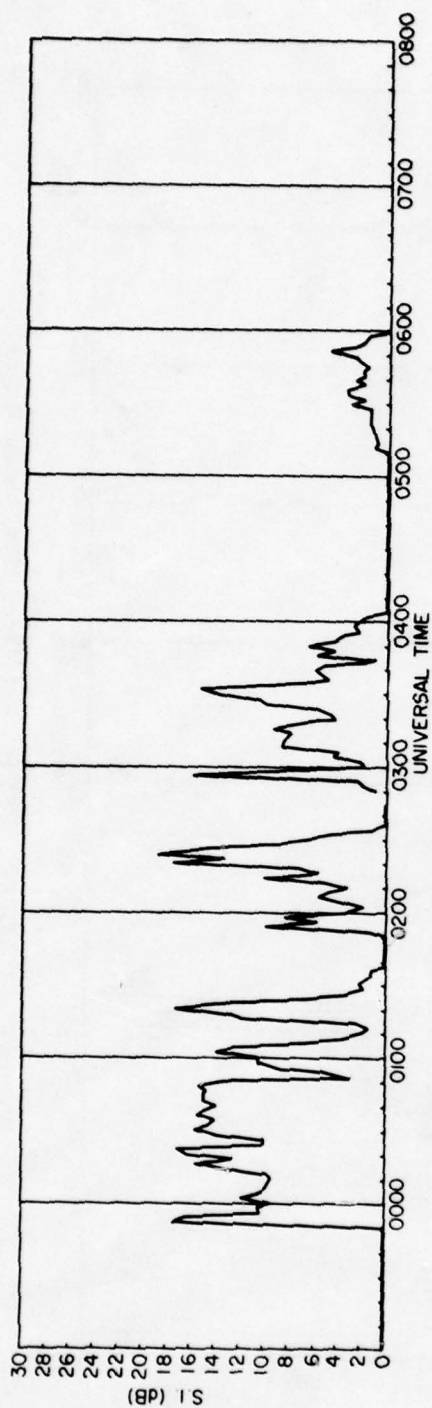


Figure 44. LES-9, 249 MHz, 4 March 1978, Natal, Brazil

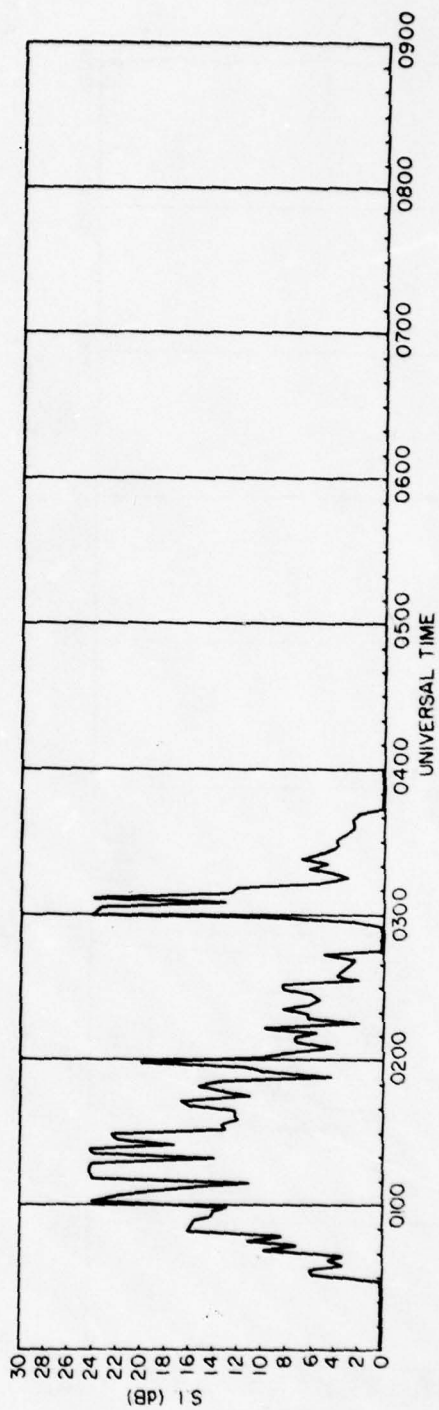


Figure 45. MARISAT, 257 MHz, 4 March 1978, Huancayo, Peru

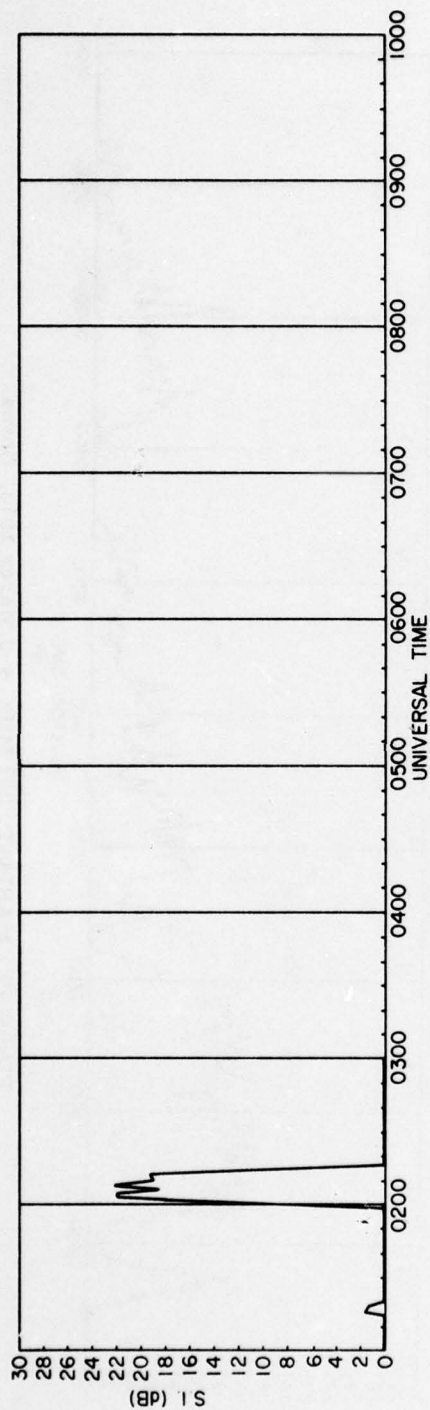


Figure 46. LES-9, 249 MHz, 4 March 1978, Huancayo, Peru

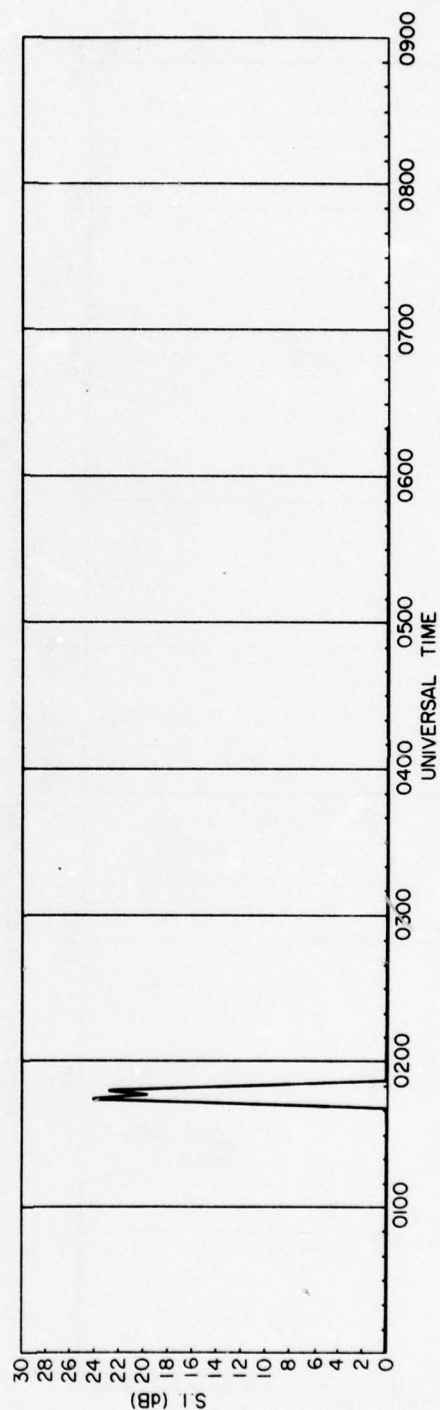


Figure 47. LES-9, 249 MHz, 4 March 1978, Ancon, Peru

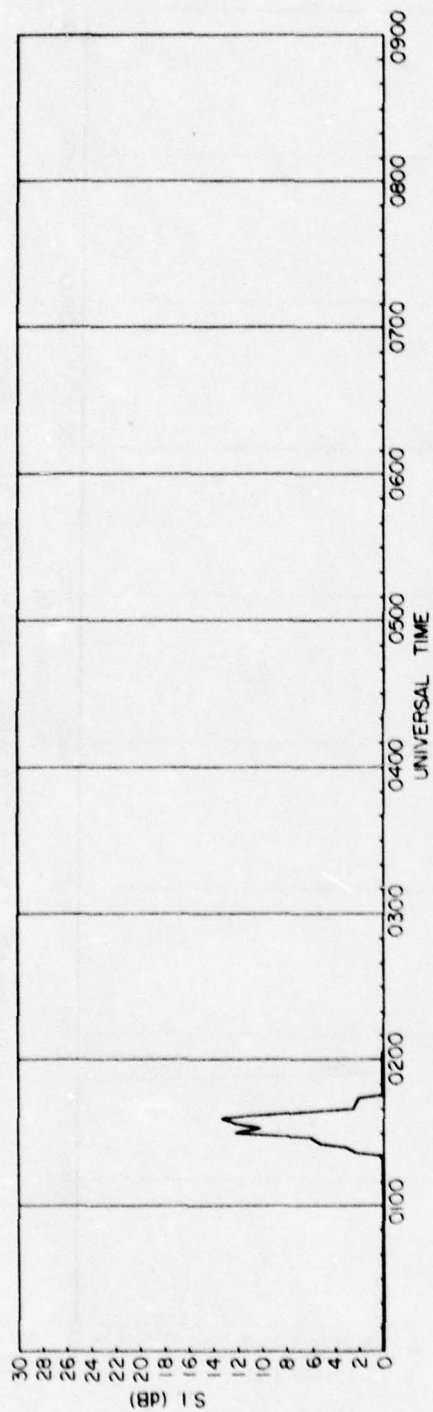


Figure 48. GOES, 136 MHz, 4 March 1978, Huancayo, Peru

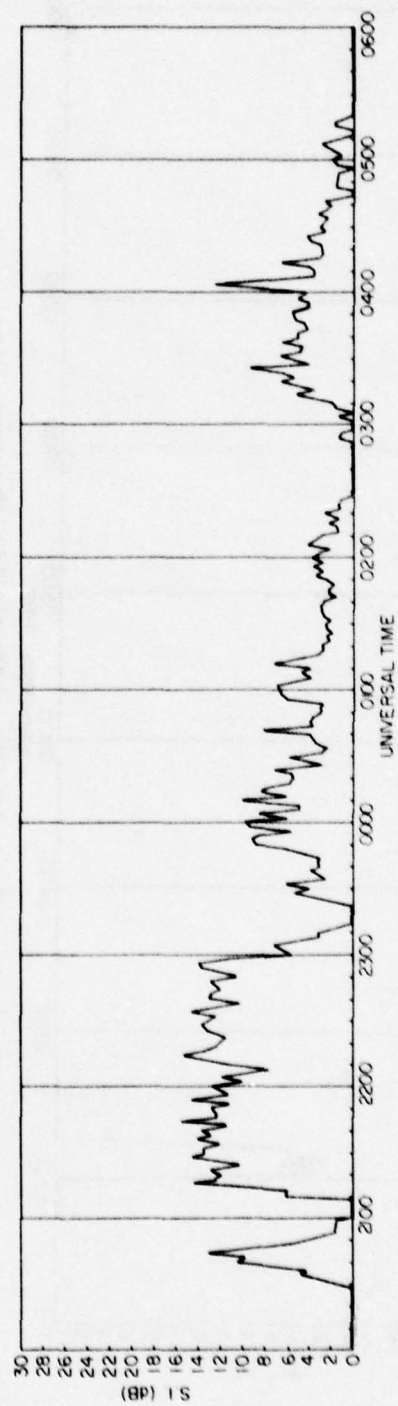


Figure 49. MARISAT, 257 MHz, 4-5 March 1978, Ghana

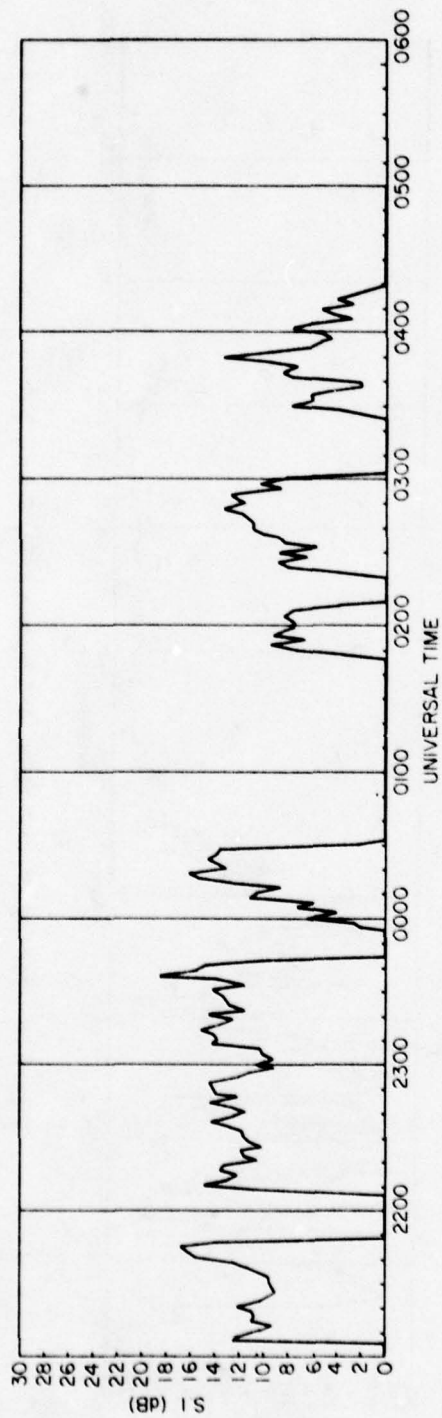


Figure 50. SIRIO, 136 MHz, 4-5 March 1978, Ascension Island

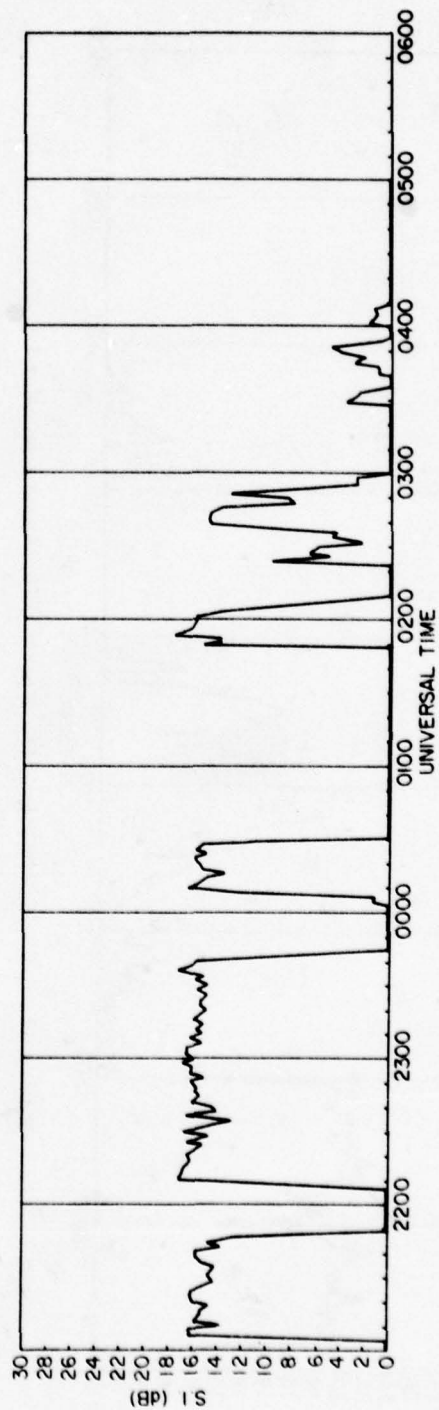


Figure 51. MARISAT, 257 MHz, 4-5 March 1978, Ascension Island

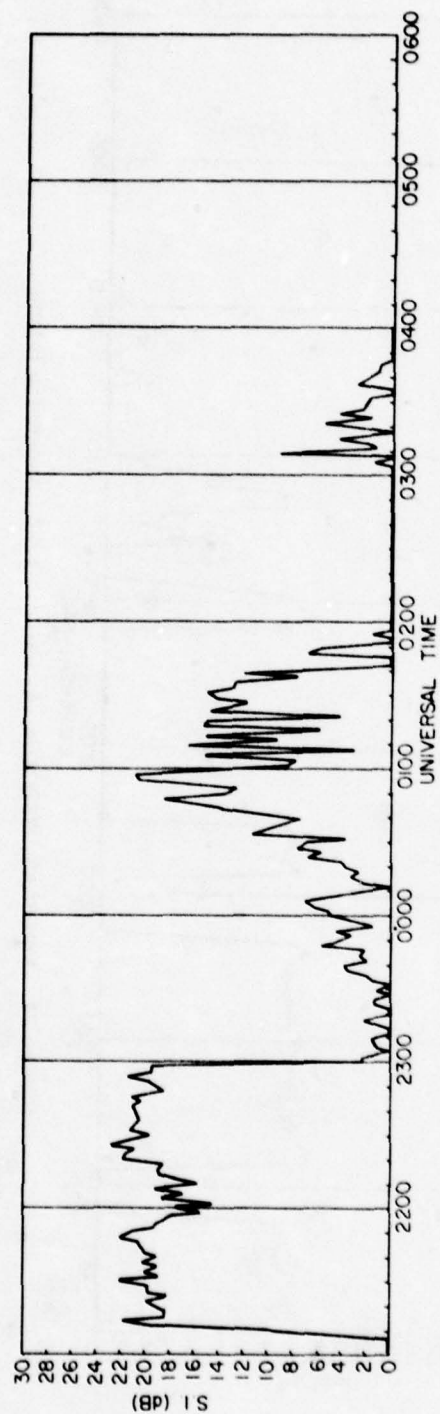


Figure 52. LES-9, 249 MHz, 4-5 March 1978, Ascension Island

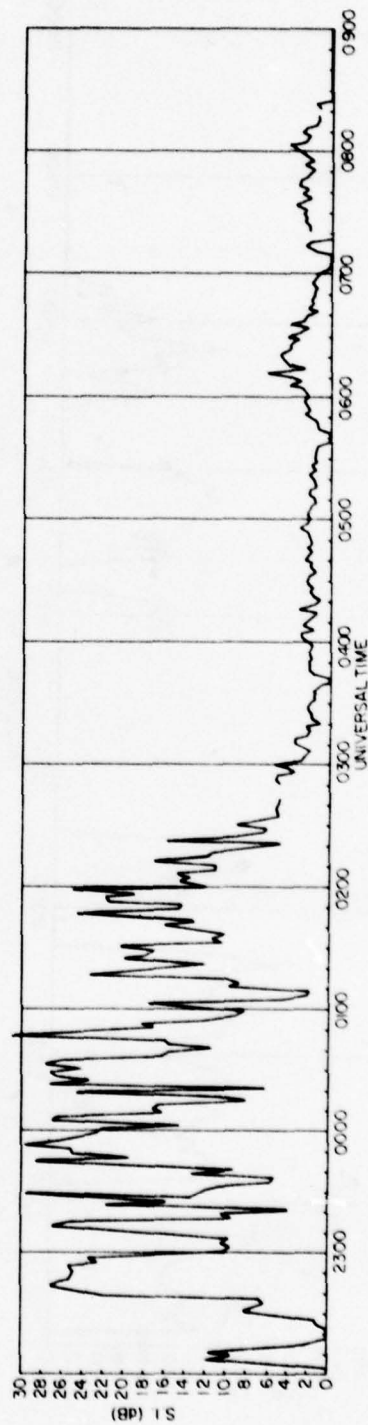


Figure 53. MARISAT, 257 MHz, 4-5 March 1978, Natal, Brazil

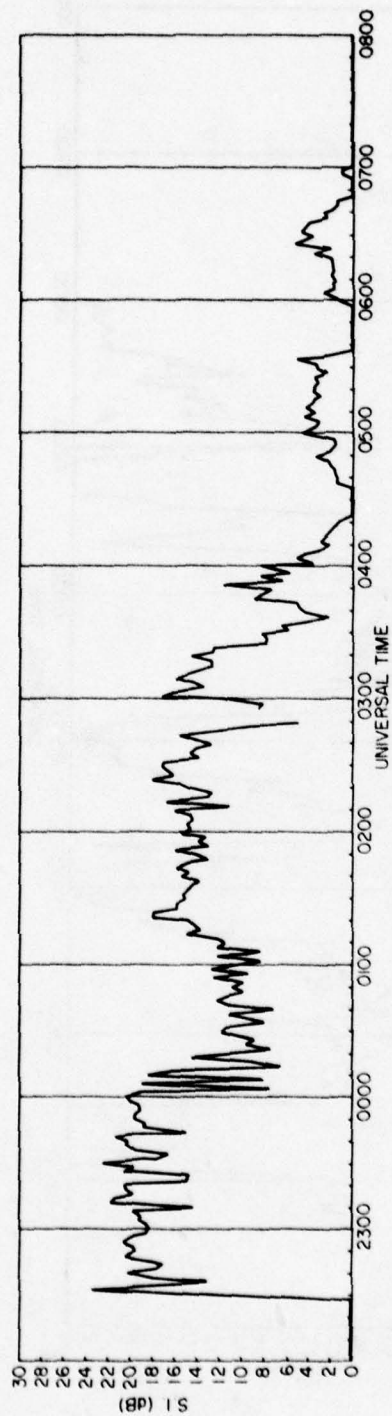


Figure 54. LES-9, 249 MHz, 4-5 March 1978, Natal, Brazil

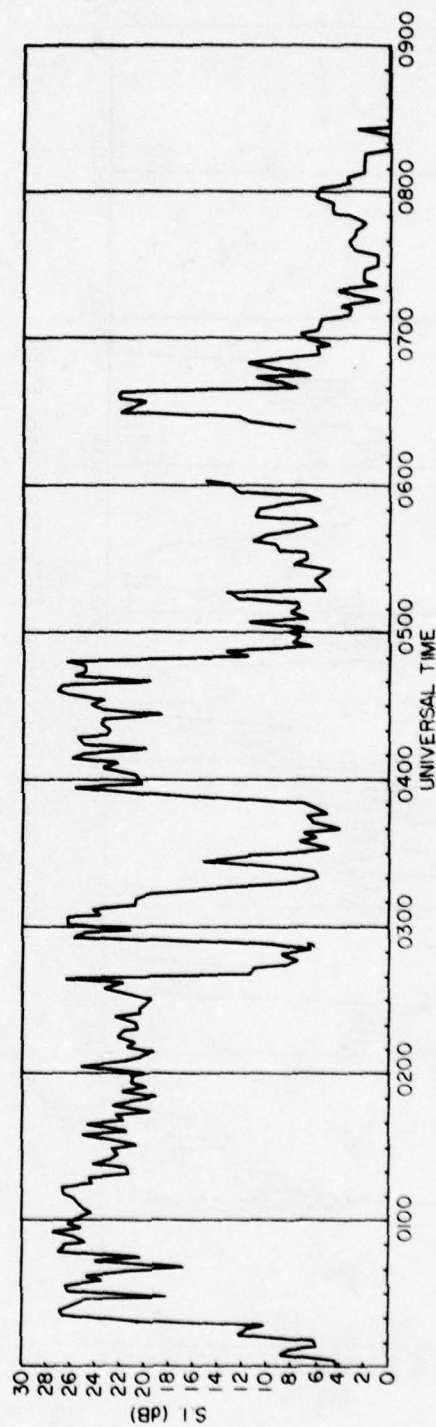


Figure 55. MARISAT, 257 MHz, 5 March 1978, Huancayo, Peru

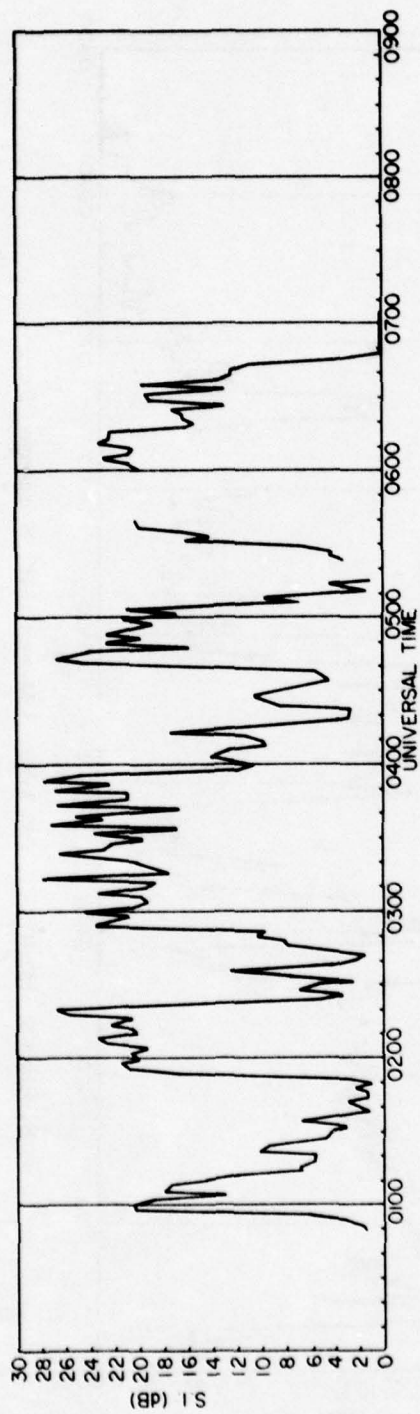


Figure 56. LES-9, 249 MHz, 5 March 1978, Huancayo, Peru

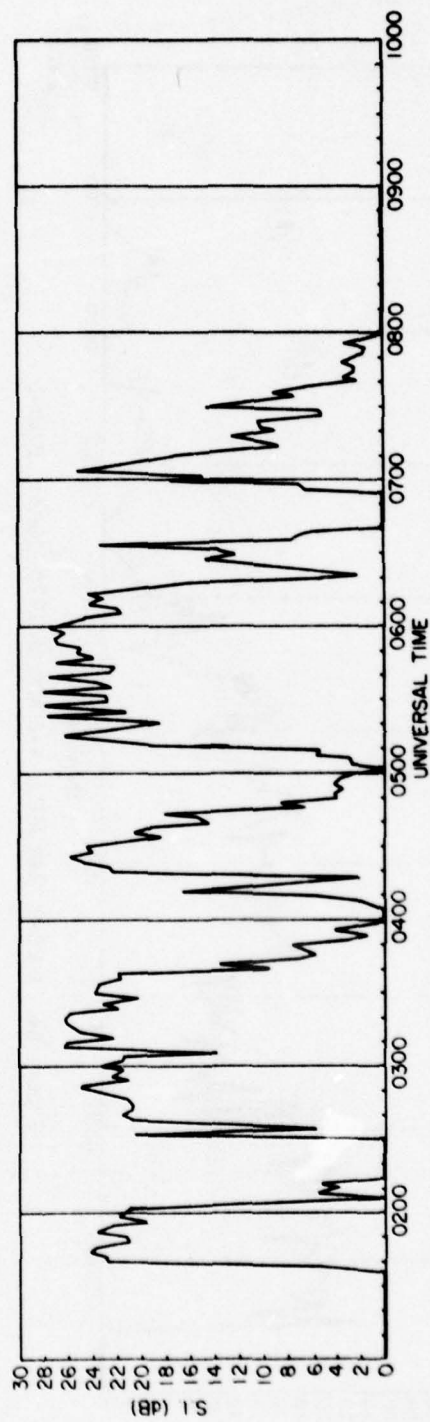


Figure 57. LES-9, 249 MHz, 5 March 1978, Ancon, Peru

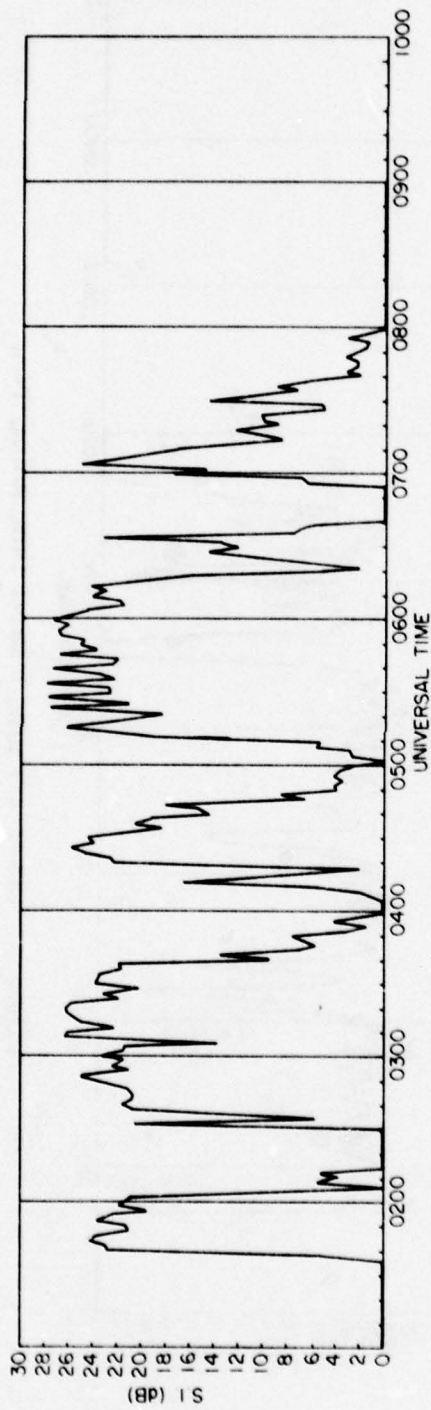


Figure 58. LES-9, 249 MHz, 5 March 1978, Ancon, Peru

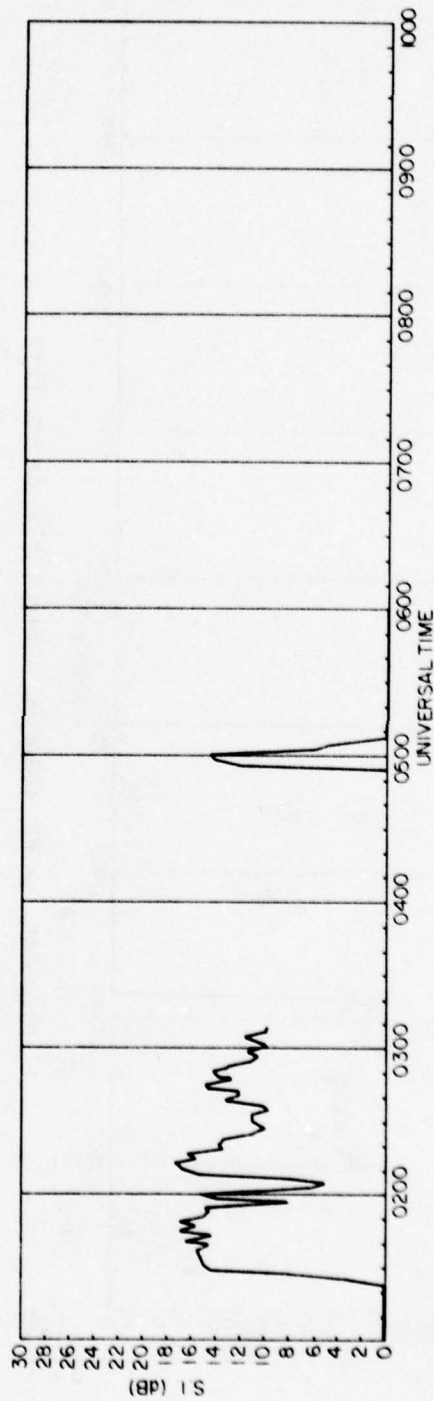


Figure 59. GOES, 136 MHz, 5 March 1978, Huancayo, Peru

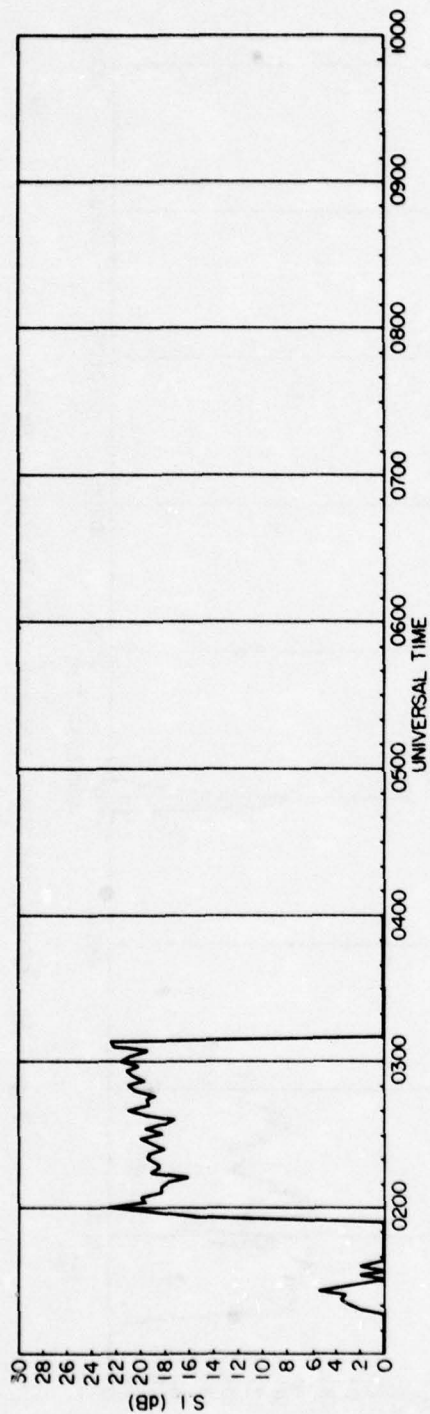


Figure 60. GOES, 136 MHz, 5 March 1978, Ancon, Peru

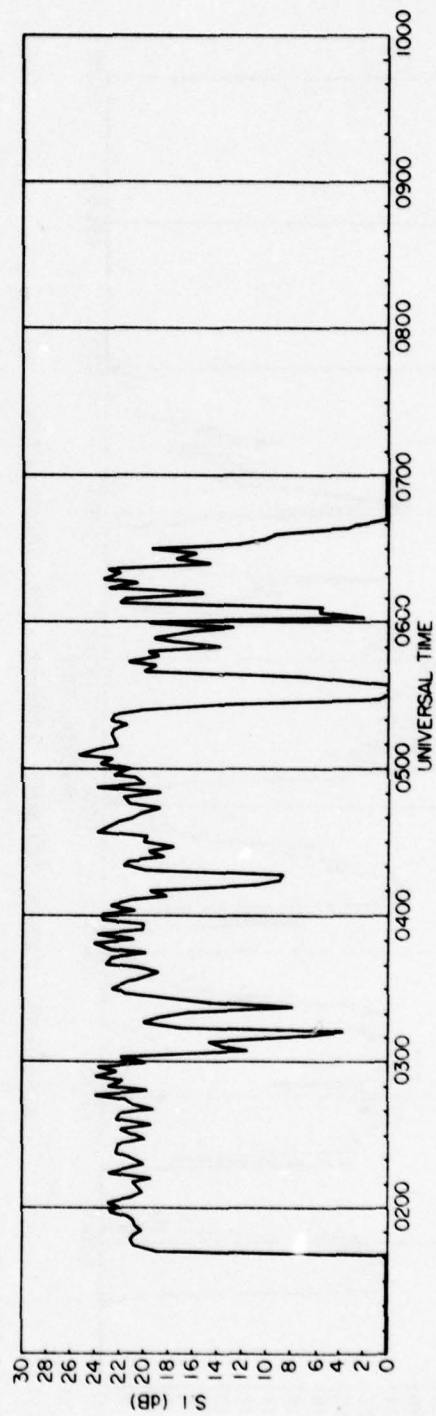


Figure 61. LES-8, 249 MHz, 5 March 1978, Ancon, Peru

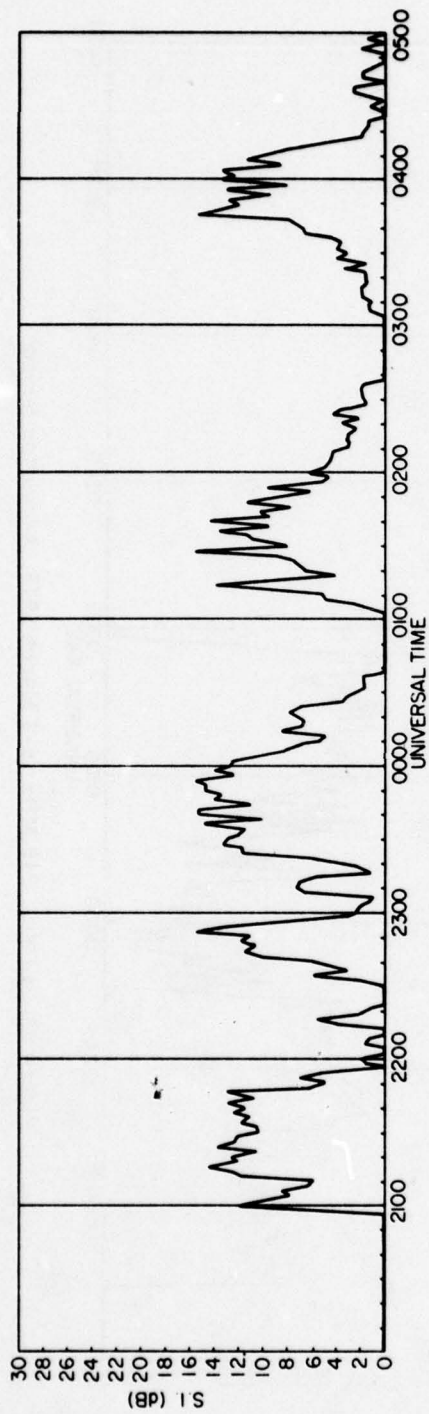


Figure 62. MARISAT, 257 MHz, 5-6 March 1978, Ghana

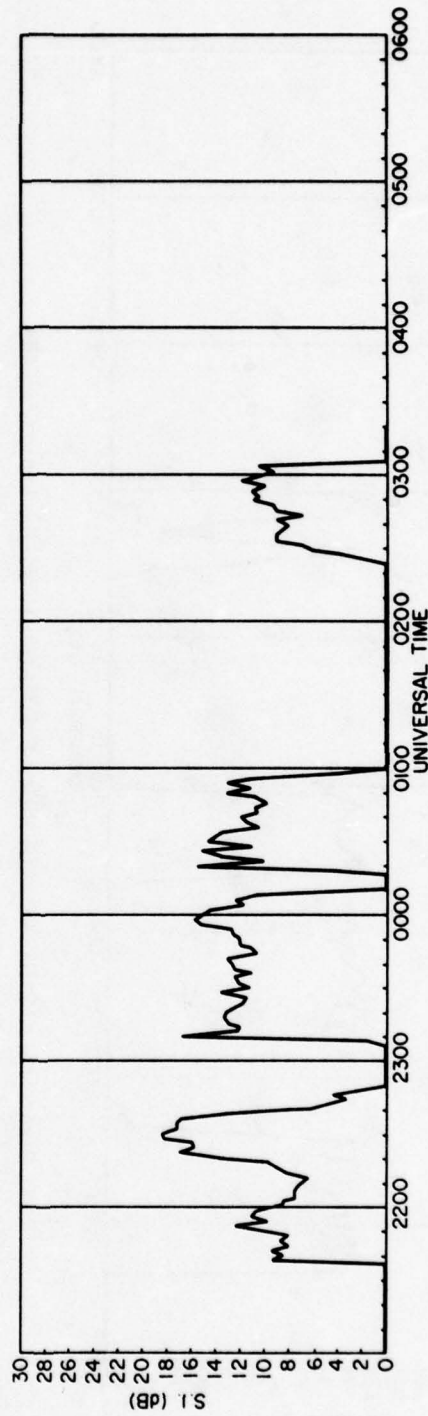


Figure 63. SIRIO, 136 MHz, 5-6 March 1978, Ascension Island

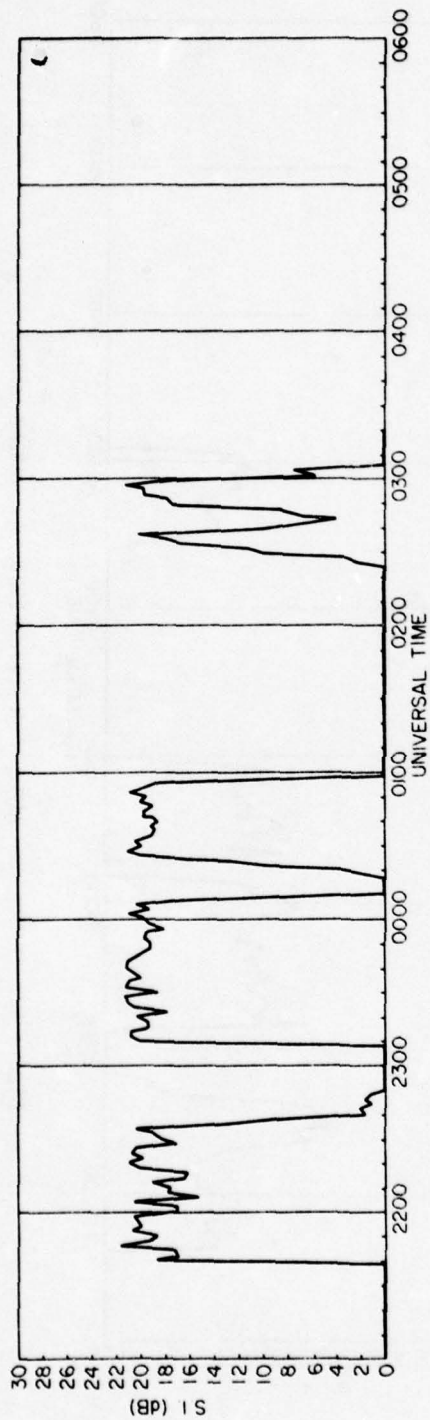


Figure 64. MARISAT, 257 MHz, 5-6 March 1978, Ascension Island

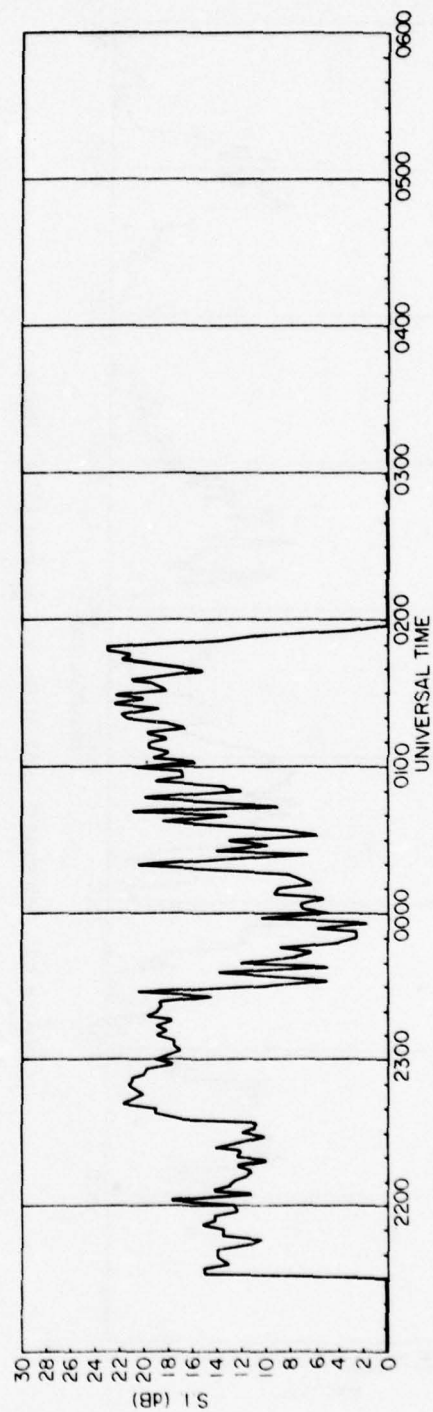


Figure 65. LES-9, 249 MHz, 5-6 March 1978, Ascension Island

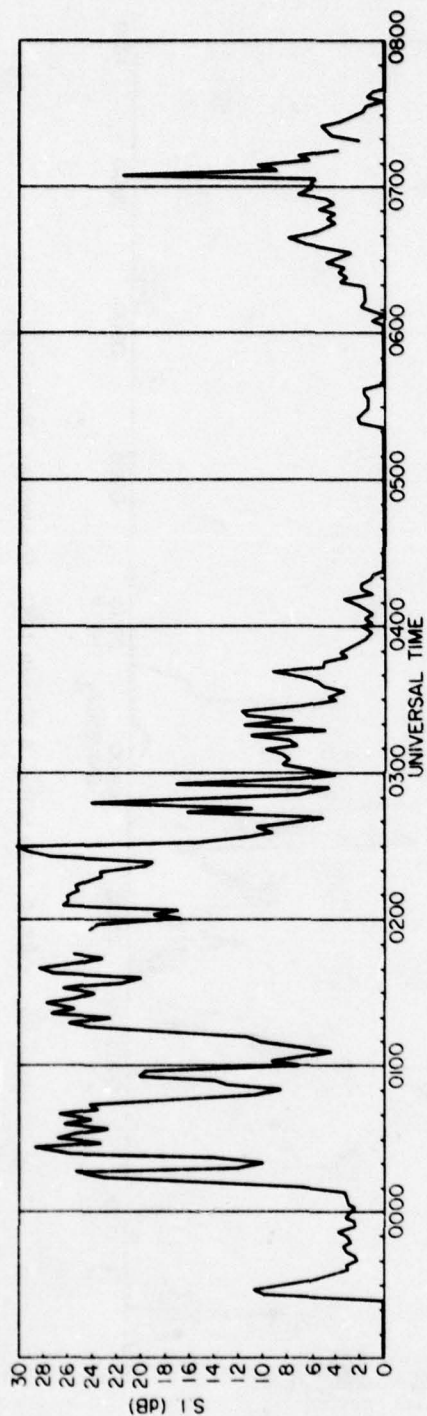


Figure 66. MARISAT, 257 MHz, 5-6 March 1978, Natal Brazil

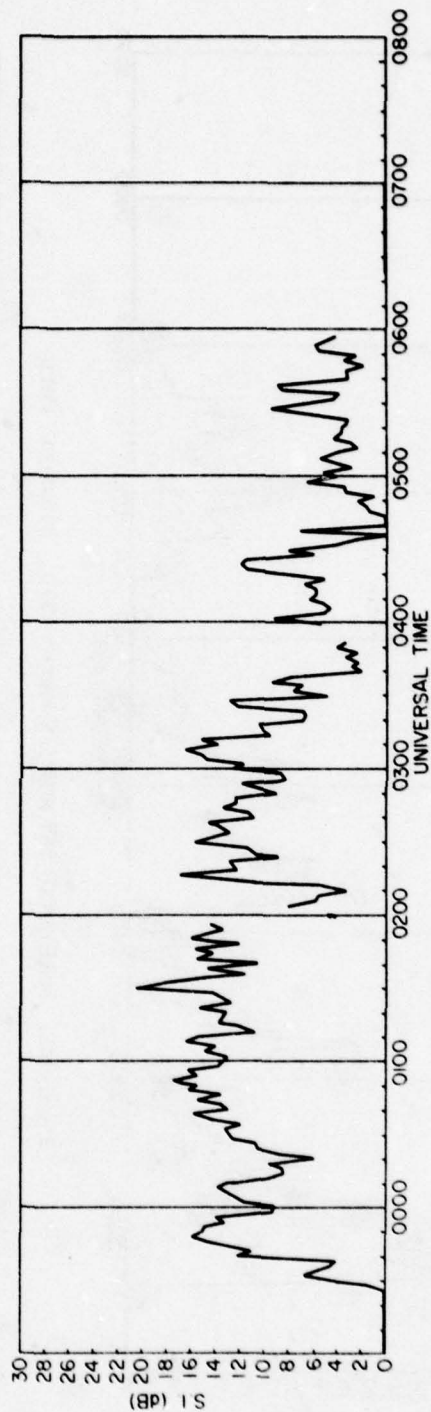


Figure 67. LES-9, 249 MHz, 5-6 March 1978, Natal, Brazil

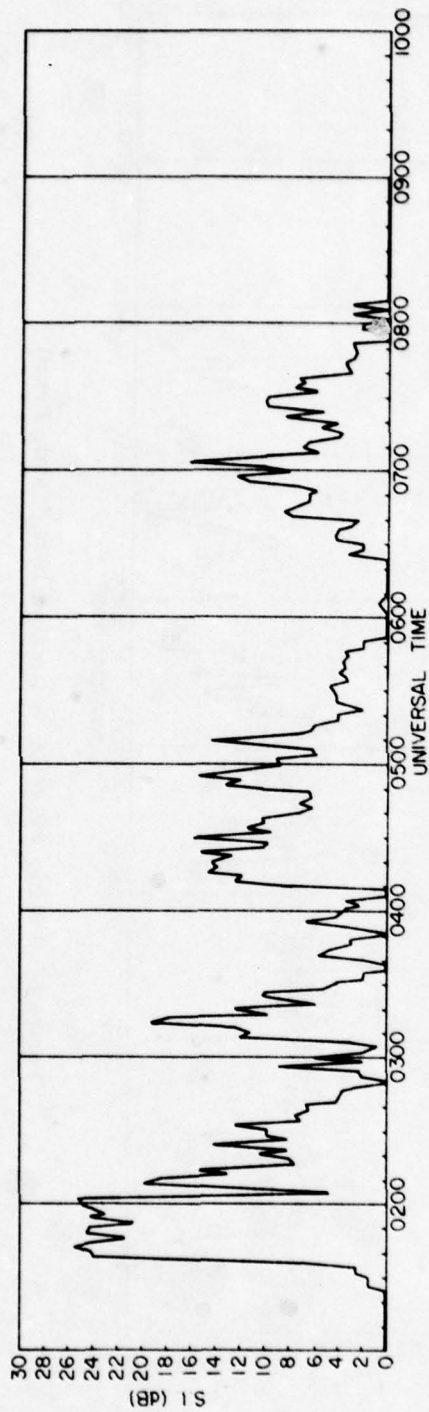


Figure 68. MARISAT, 257 MHz, 6 March 1978, Huancayo, Peru

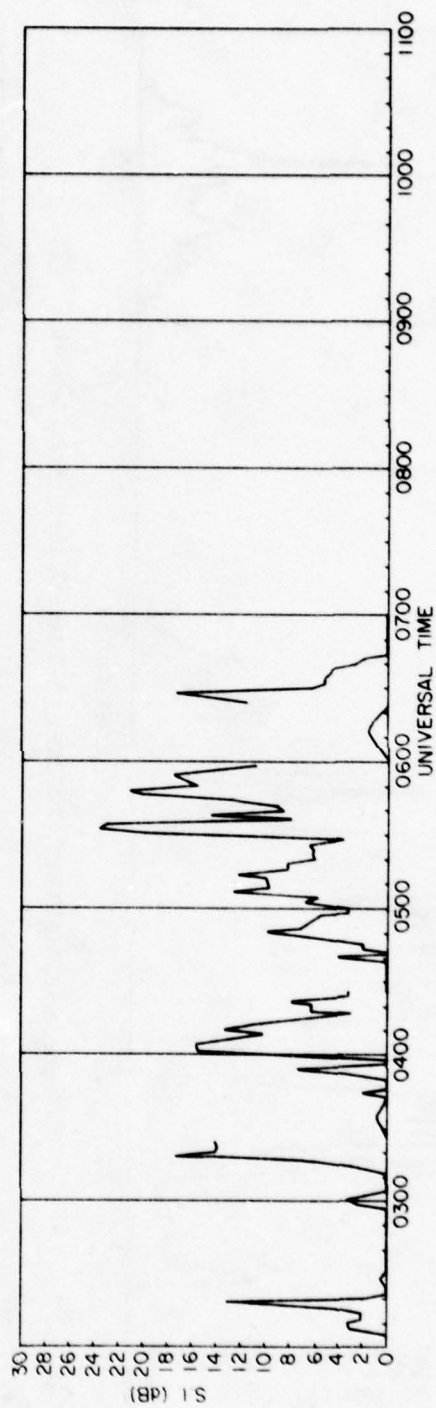


Figure 69. LES-9, 249 MHz, 6 March 1978, Huancayo, Peru

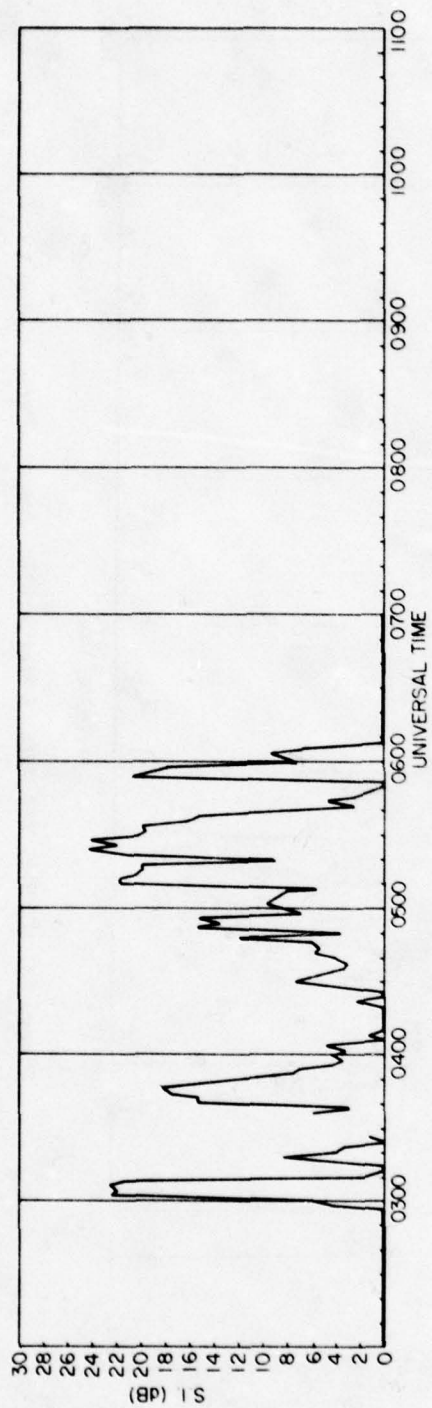


Figure 70. LES-9, 249 MHz, 6 March 1978, Ancon, Peru

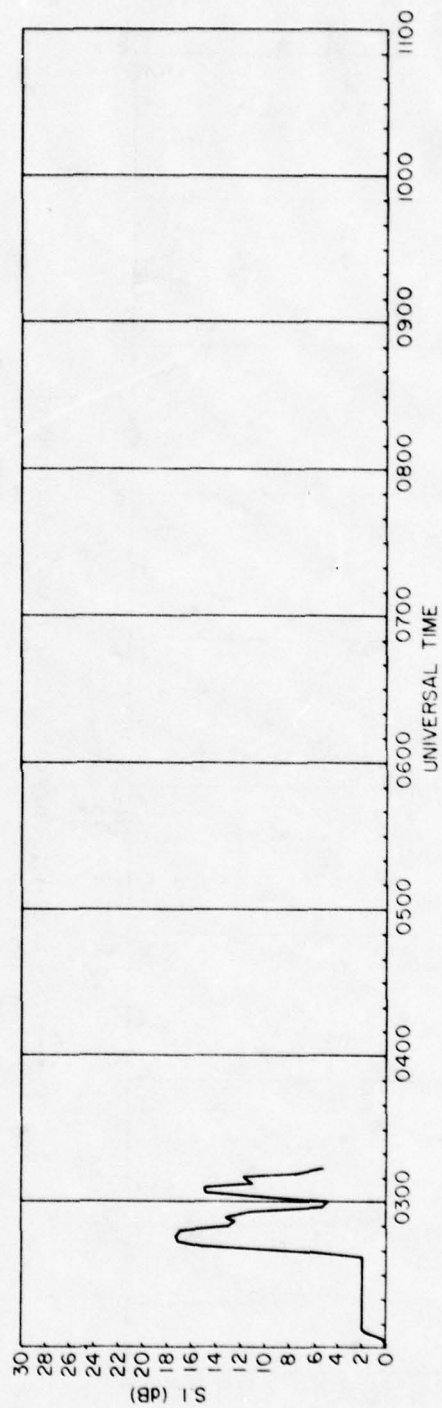


Figure 71. GOES, 136 MHz, 6 March 1978, Huancayo, Peru

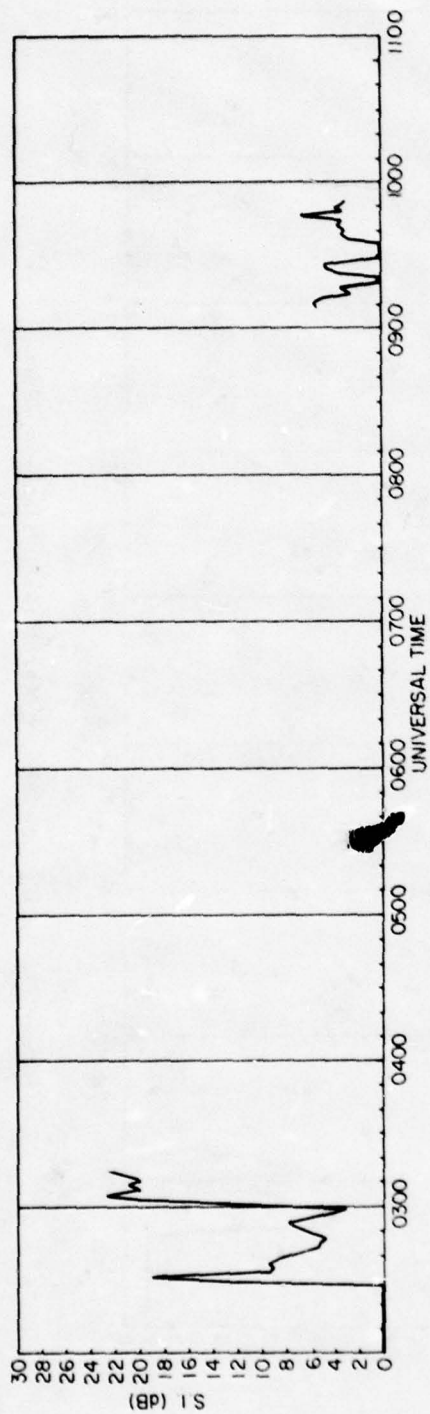


Figure 72. GOES-1, 136 MHz, 6 March 1978, Ancon Peru

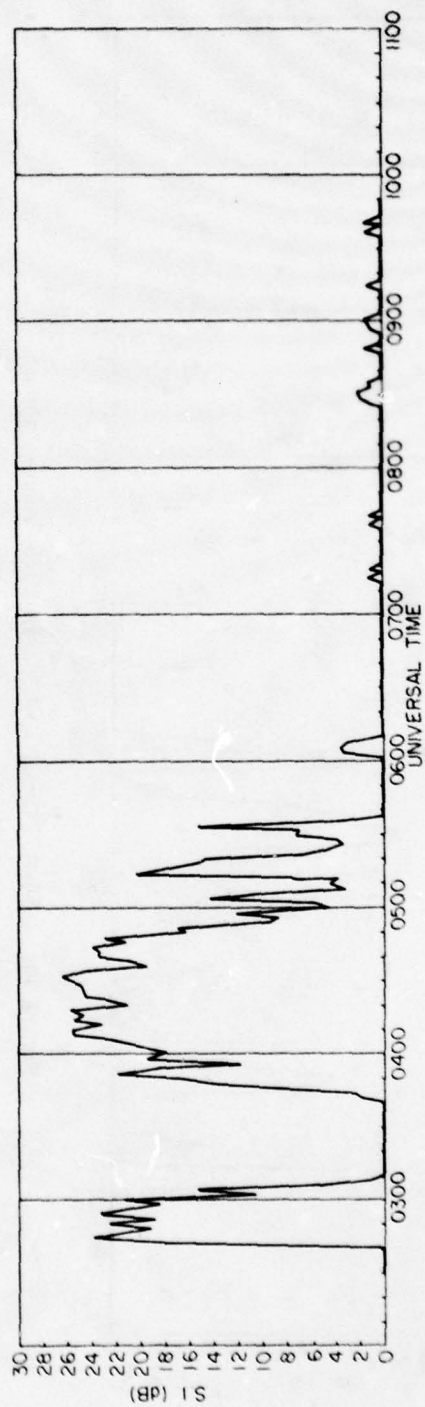


Figure 73. LES-8, 249 MHz, 6 March 1978, Ancon, Peru

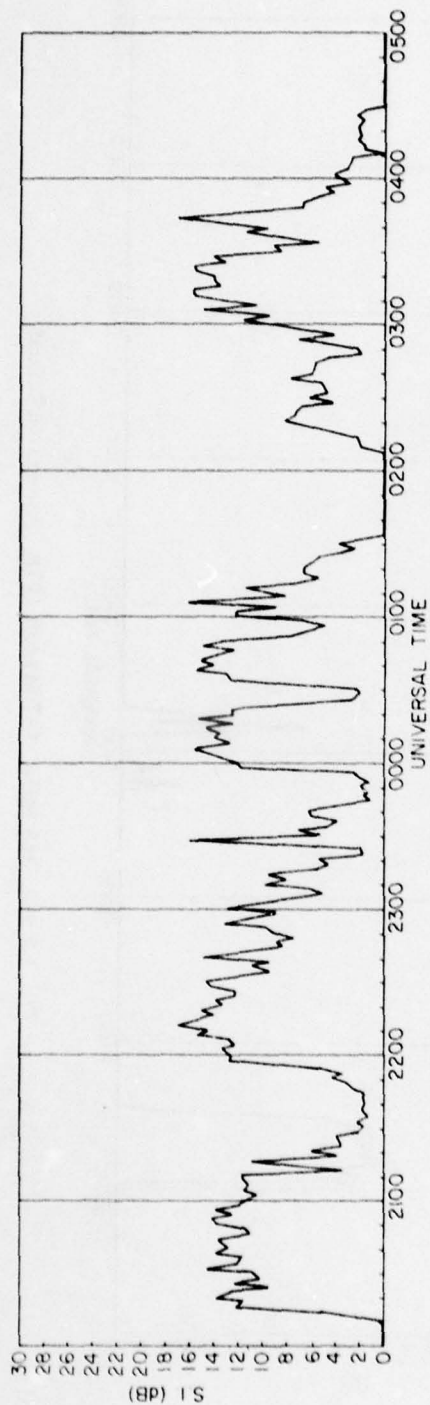


Figure 74. MARISAT, 257 MHz, 6-7 March 1978, Ghana

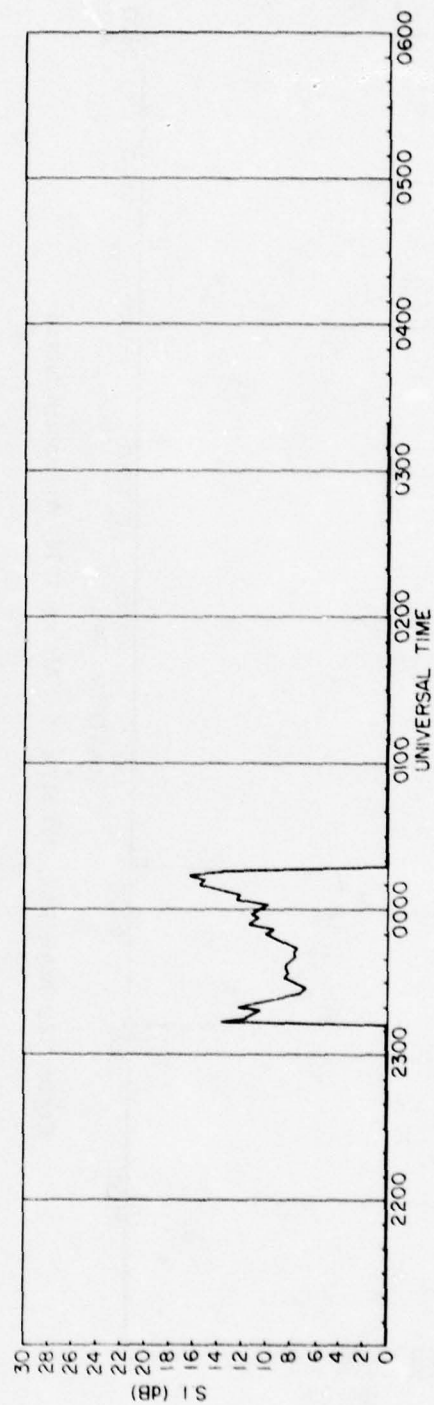


Figure 75. SIRIO, 136 MHz, 6-7 March 1978, Ascension Island

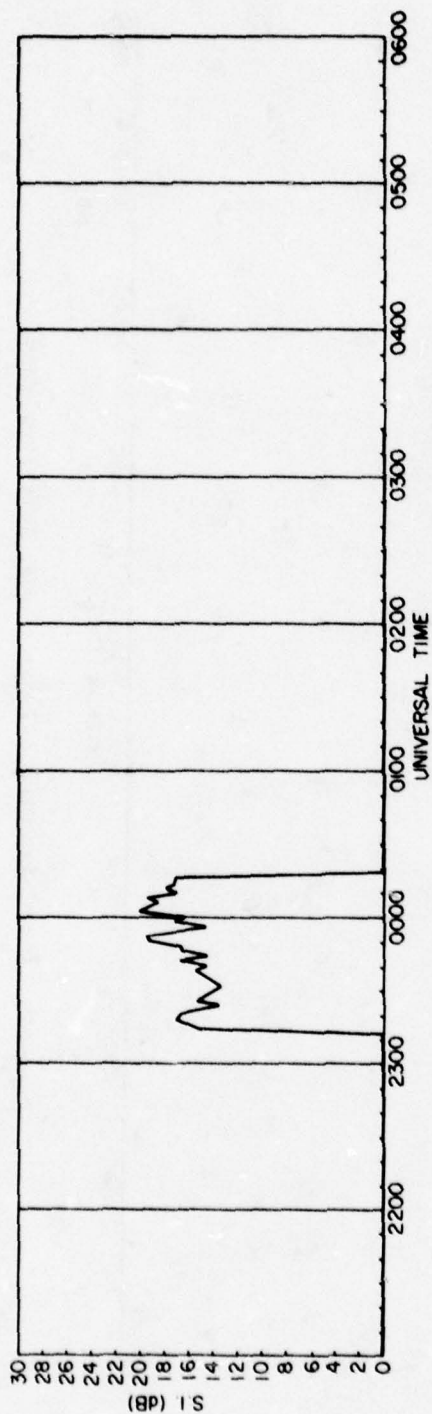


Figure 76. MARISAT, 257 MHz, 6-7 March 1978, Ascension Island

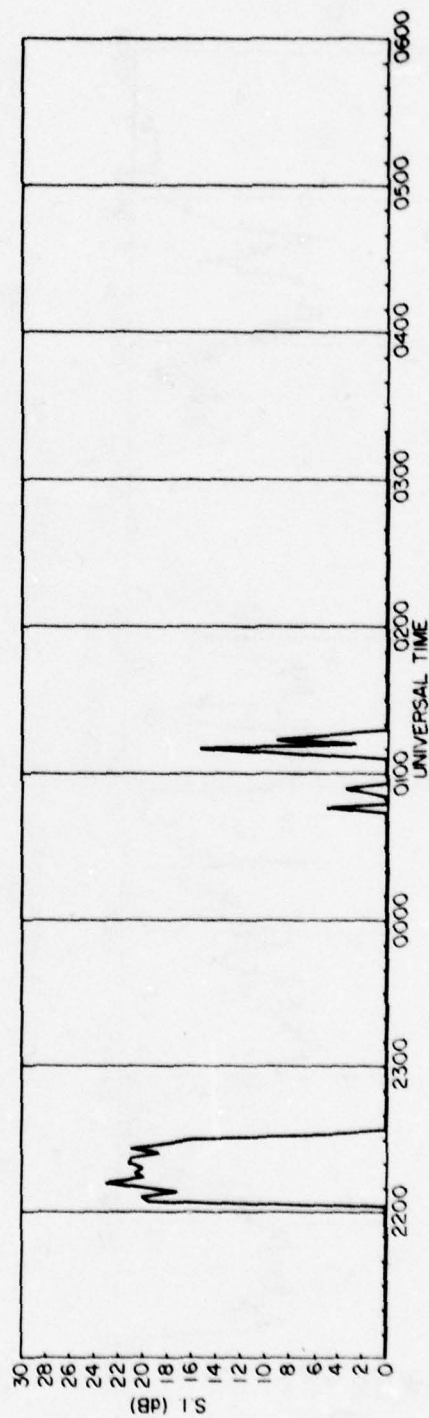


Figure 77. LES-9, 249 MHz, 6-7 March 1978, Ascension Island

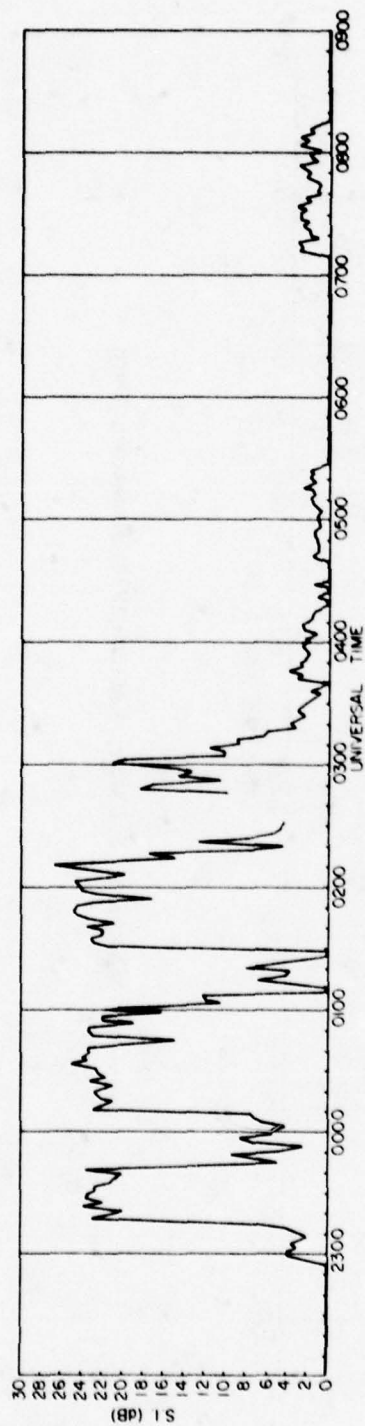


Figure 78. MARISAT, 257 MHz, 6-7 March 1978, Natal Brazil

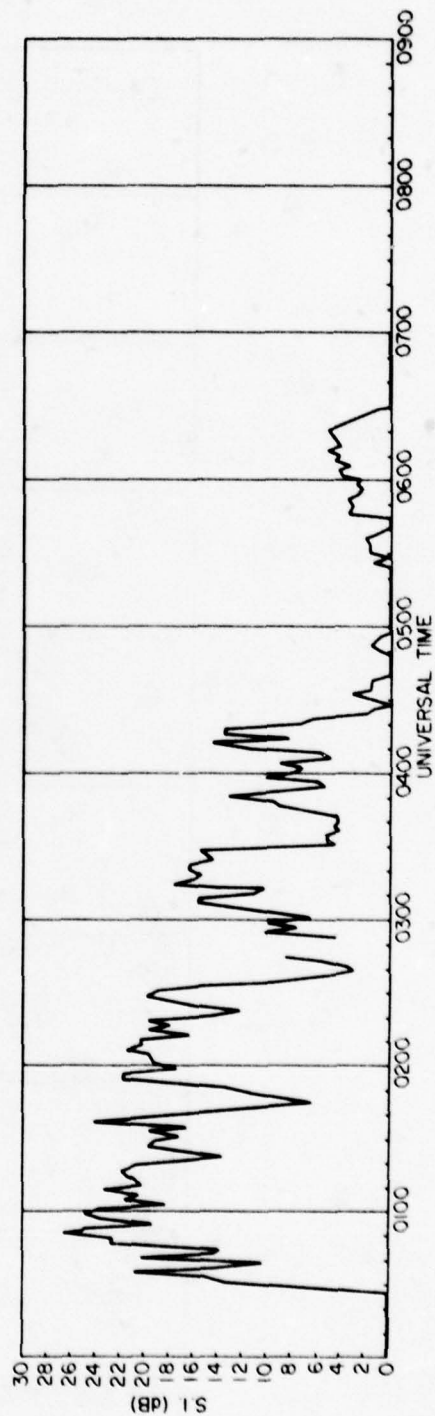


Figure 79. LES-9, 249 MHz, 7 March 1978, Natal, Brazil

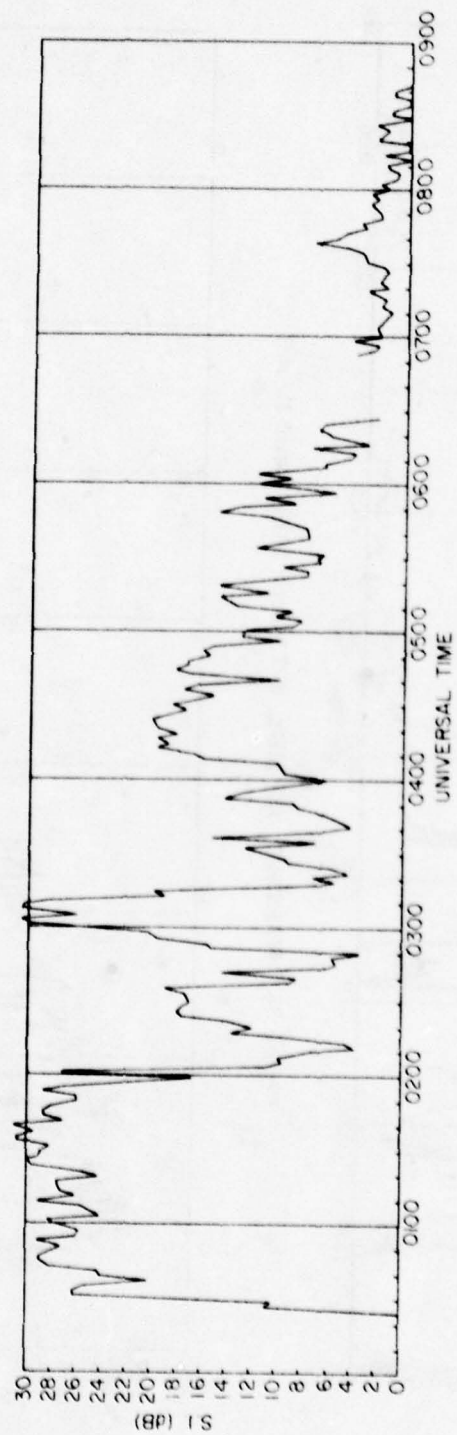


Figure 80. MARISAT, 257 MHz, 7 March 1978, Huancayo, Peru

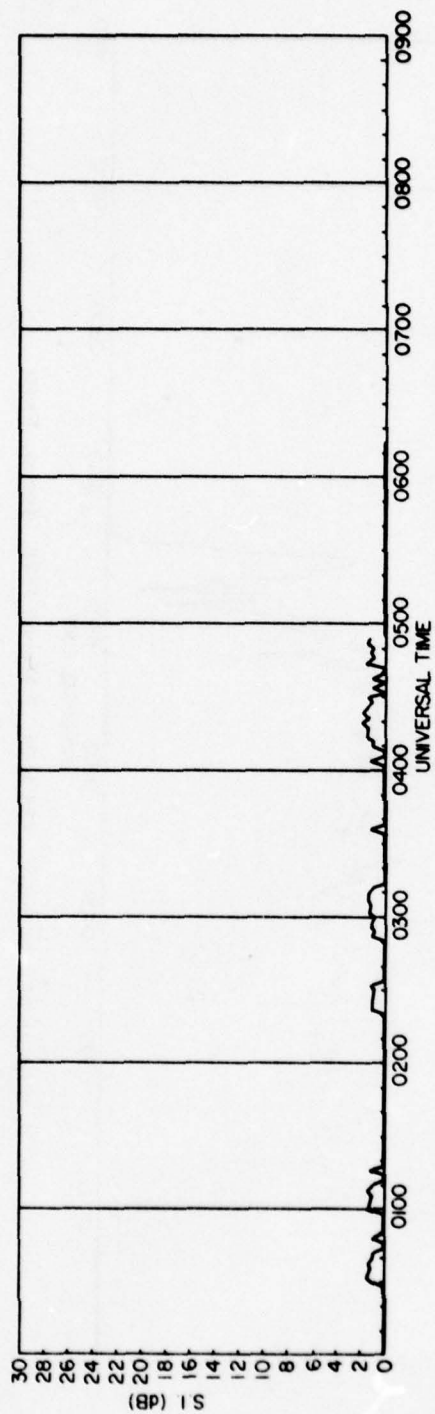


Figure 81. MARISAT, 1541 MHz, 7 March 1978, Huancayo, Peru

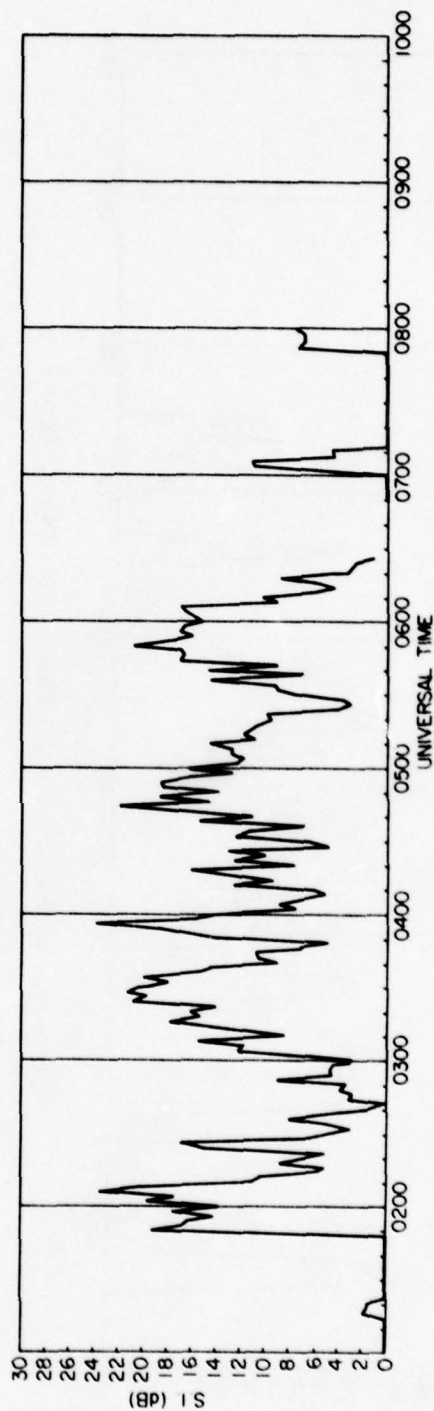


Figure 82. LES-9, 249 MHz, 7 March 1978, Huancayo, Peru

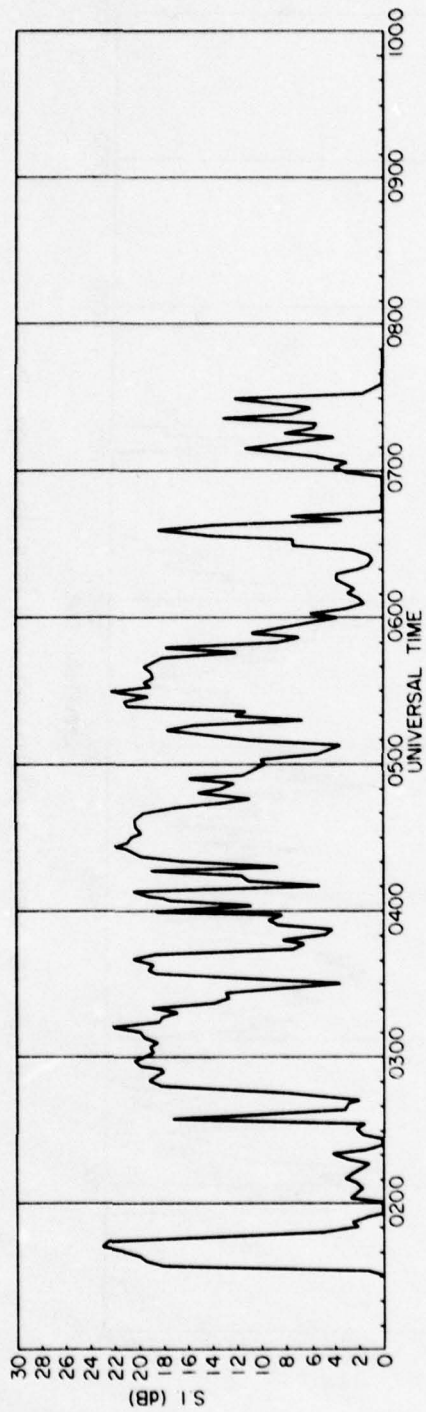


Figure 83. LES-9, 249 MHz, 7 March 1978, Ancon, Peru

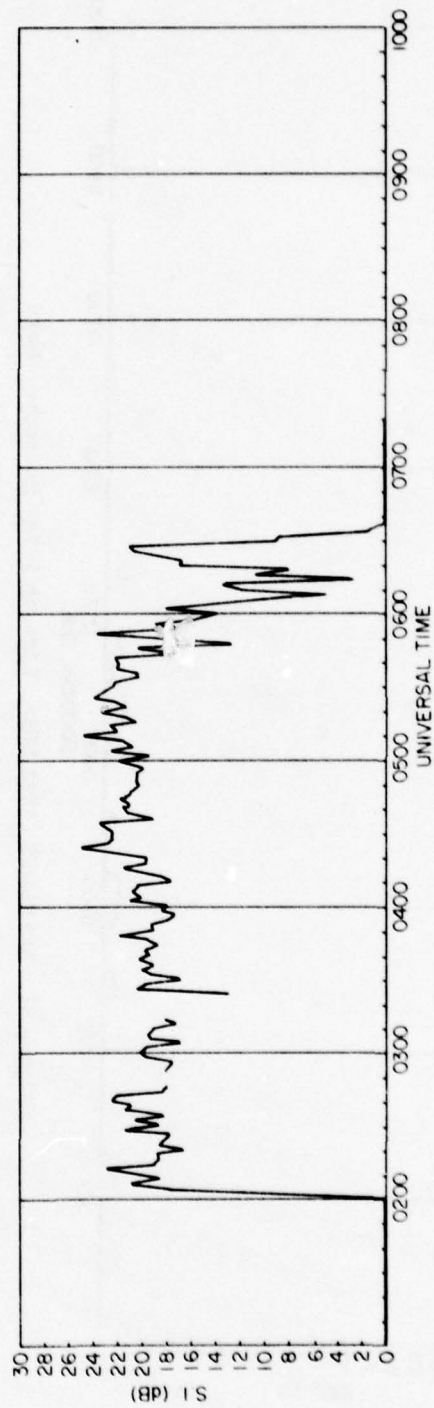


Figure 84. GOES-1, 136 MHz, 7 March 1978, Ancon, Peru

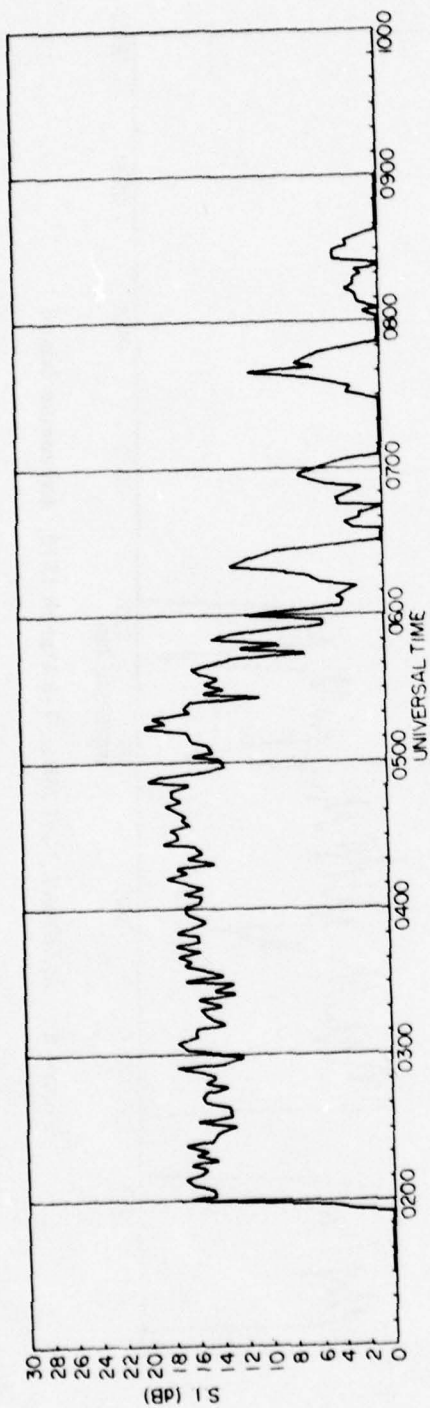


Figure 85. LES-8, 249 MHz, 7 March 1978, Ancon, Peru

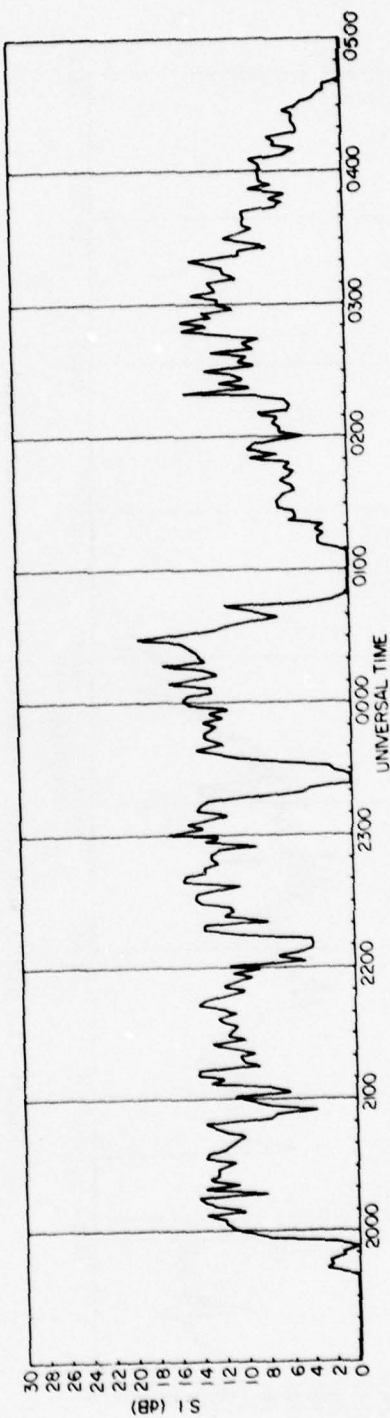


Figure 86. MARISAT, 257 MHz, 7-8 March 1978, Ghana

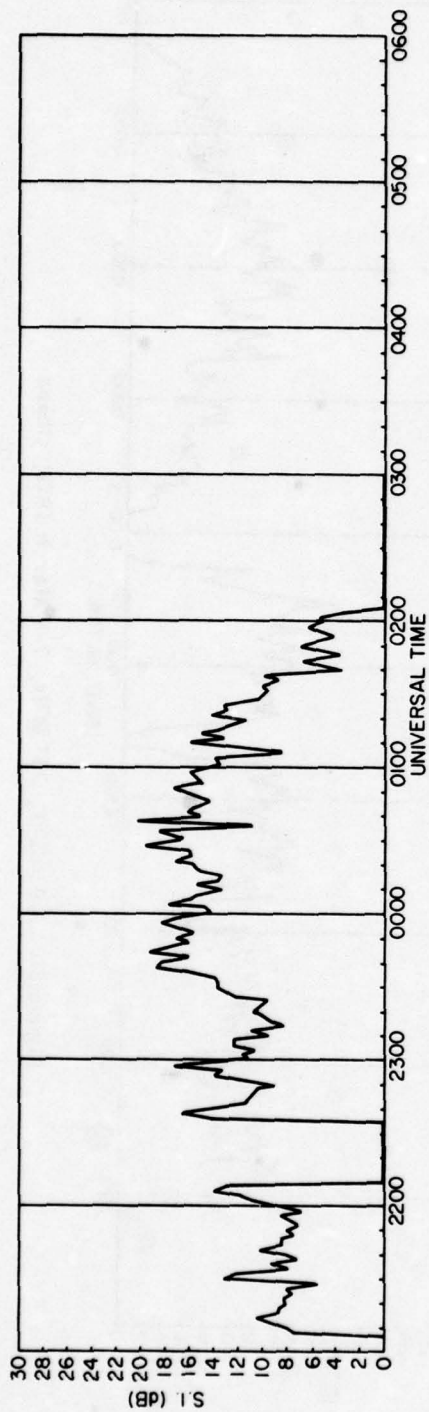


Figure 87. SIRIO, 136 MHz, 7-8 March 1978, Ascension Island

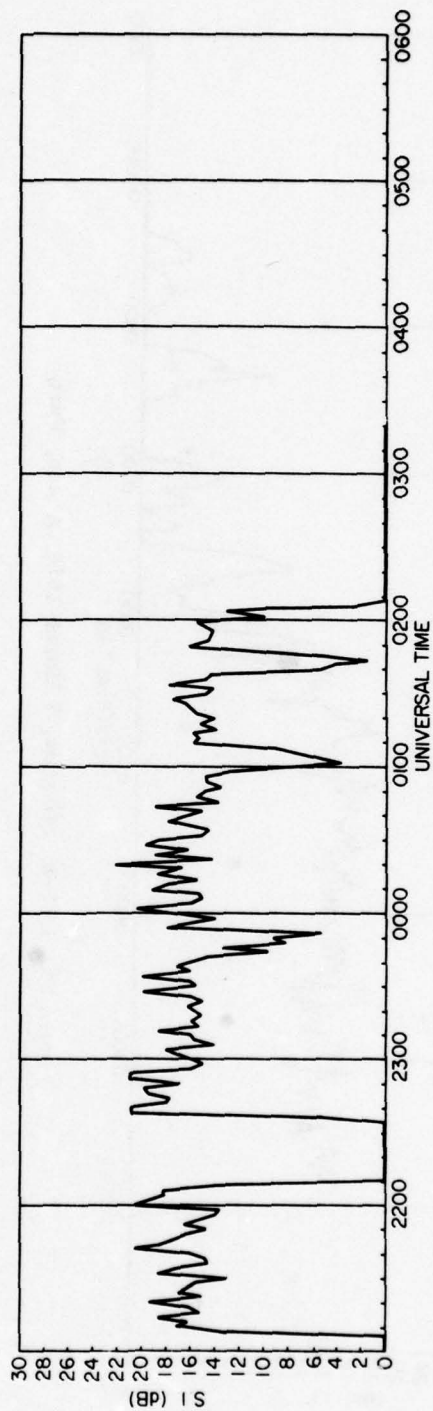


Figure 88. MARISAT, 257 MHz, 7-8 March 1978, Ascension Island

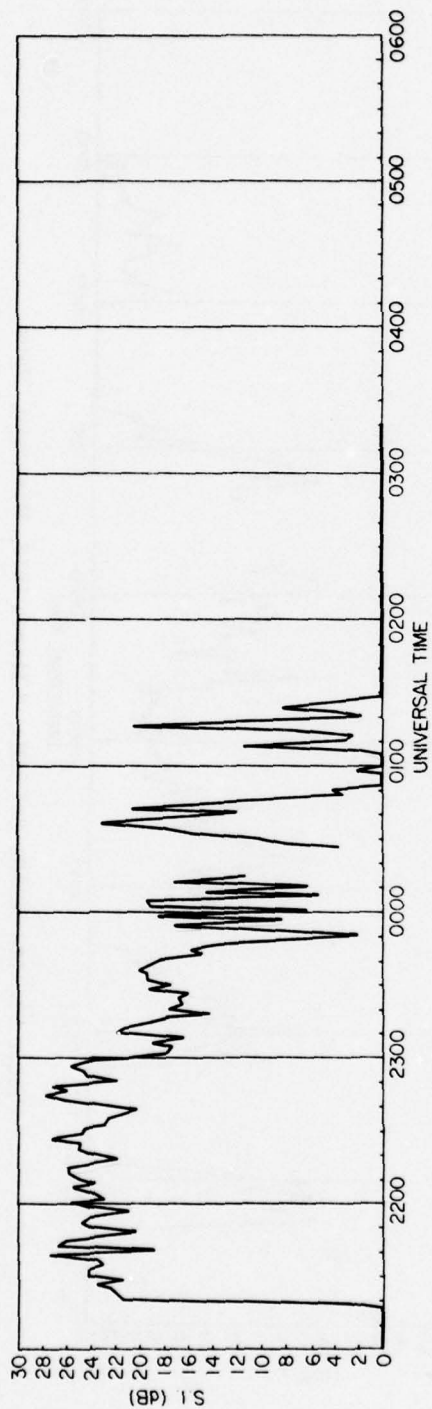


Figure 89. LES-9, 249 MHz, 7-8 March 1978, Ascension Island

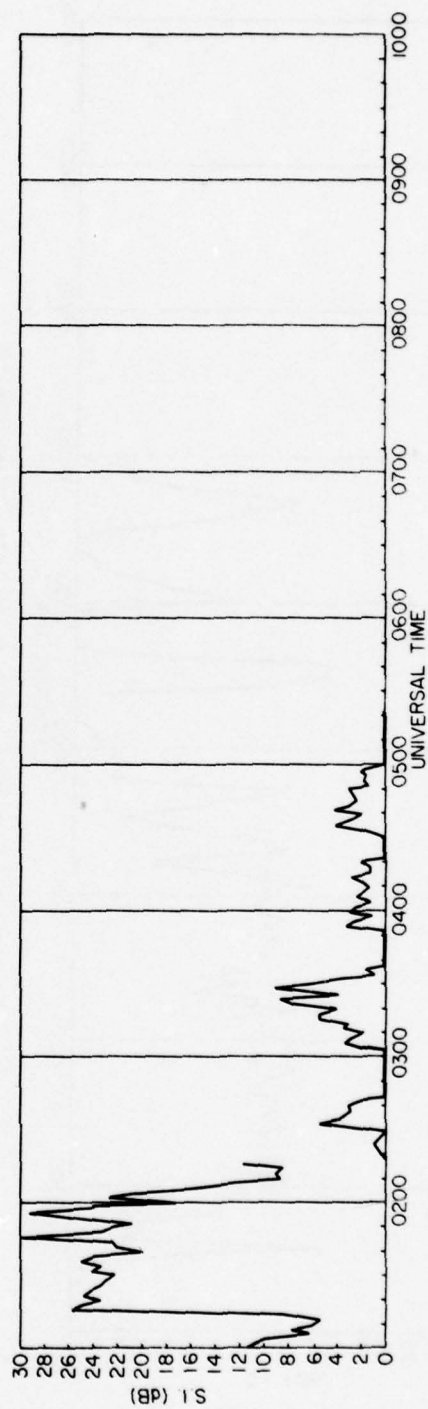


Figure 90. MARISAT, 257 MHz, 8 March 1978, Natal, Brazil

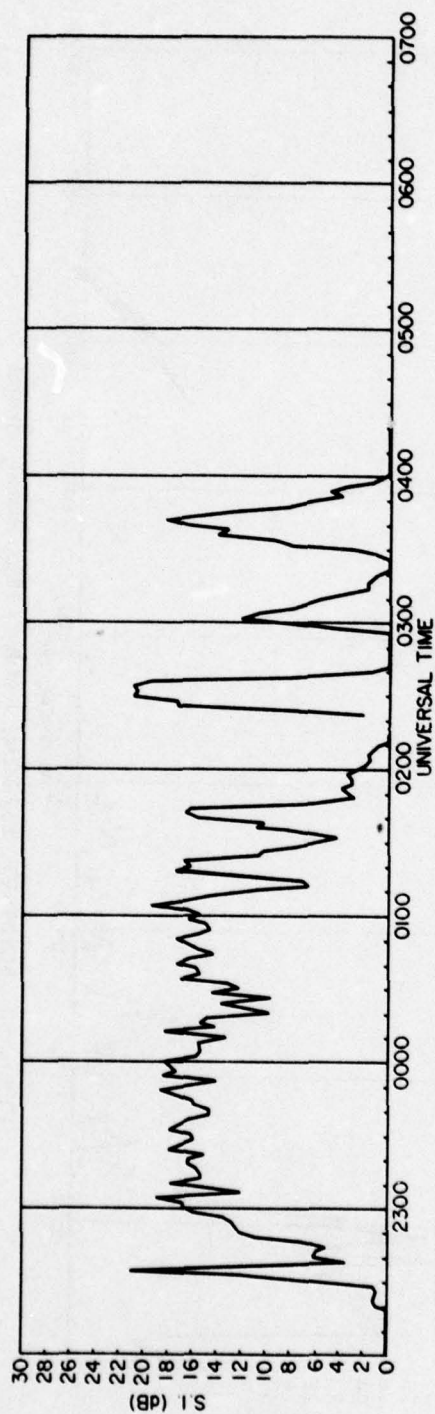


Figure 91. LES-9, 249 MHz, 7-8 March 1978, Natal, Brazil

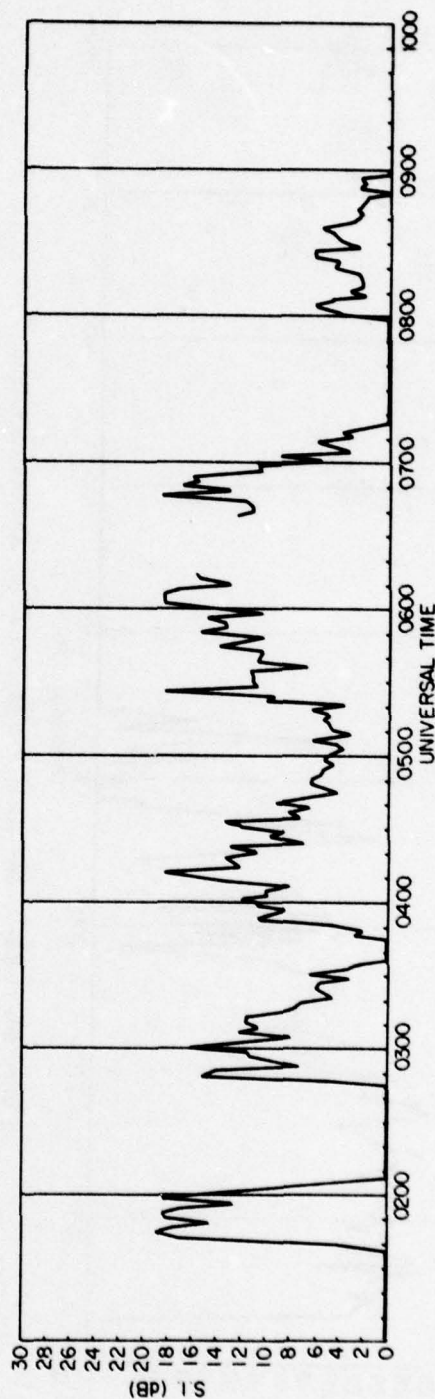


Figure 92. MARISAT, 257 MHz, 8 March 1978, Huancayo, Peru

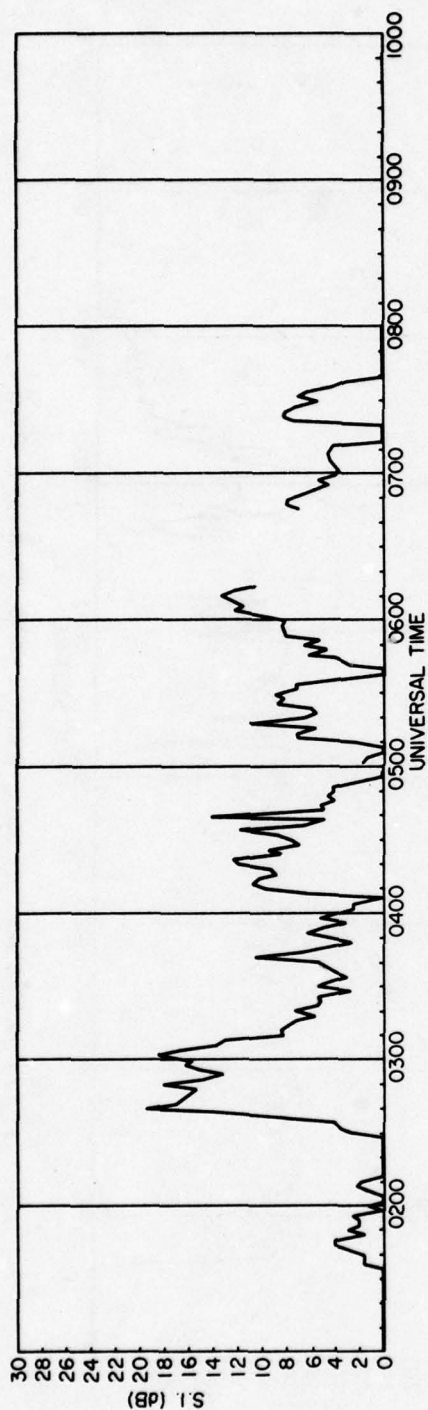


Figure 93. LES-9, 249 MHz, 8 March 1978, Huancayo, Peru

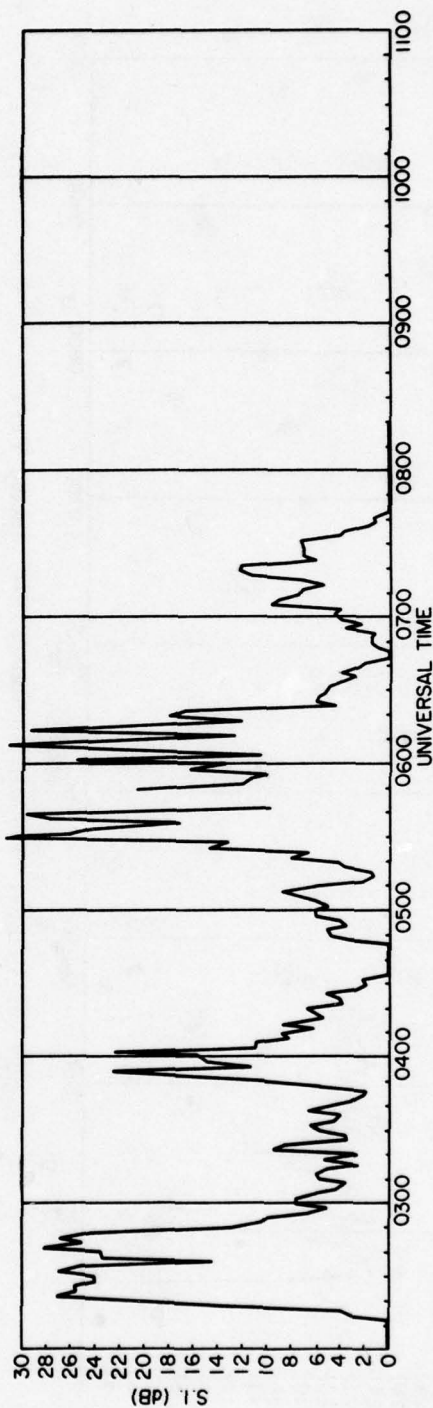


Figure 94. LES-9, 249 MHz, 8 March 1978, Ancon, Peru

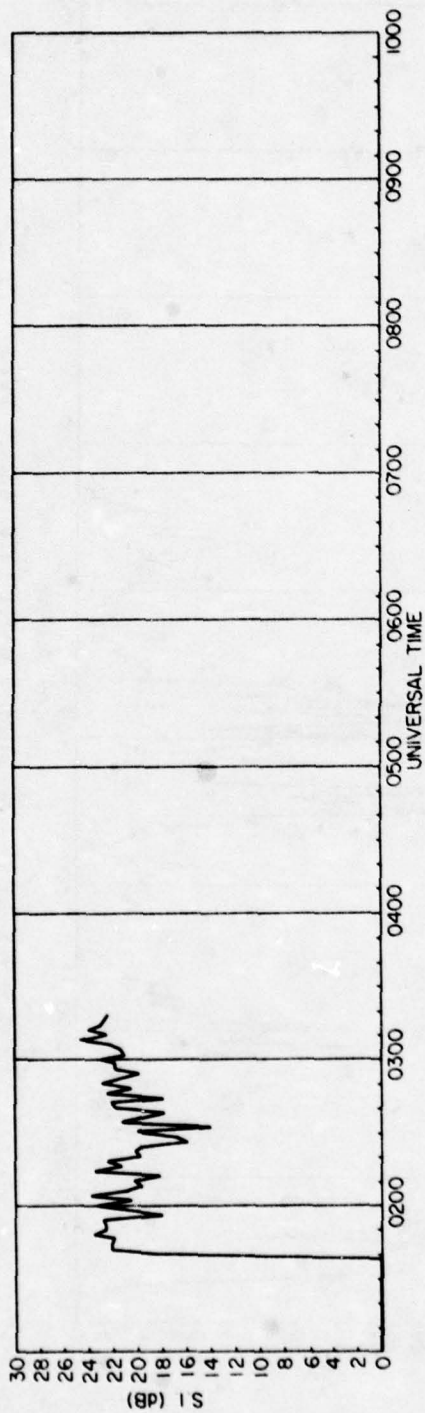


Figure 95. GOES-1, 136 MHz, 8 March 1978, Ancon, Peru

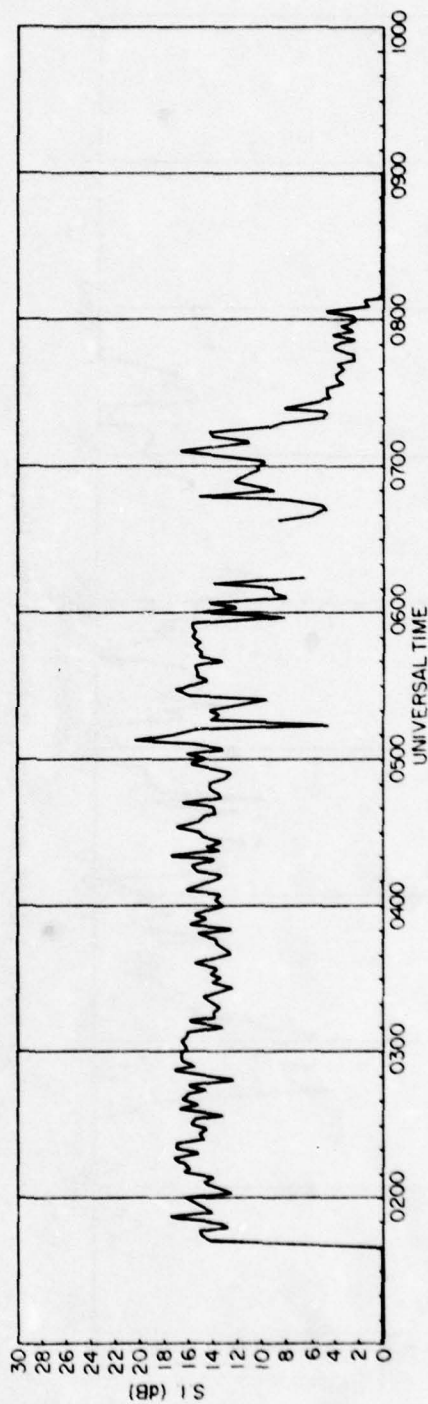


Figure 96. ATS-3, 136 MHz, 8 March 1978, Huancayo, Peru

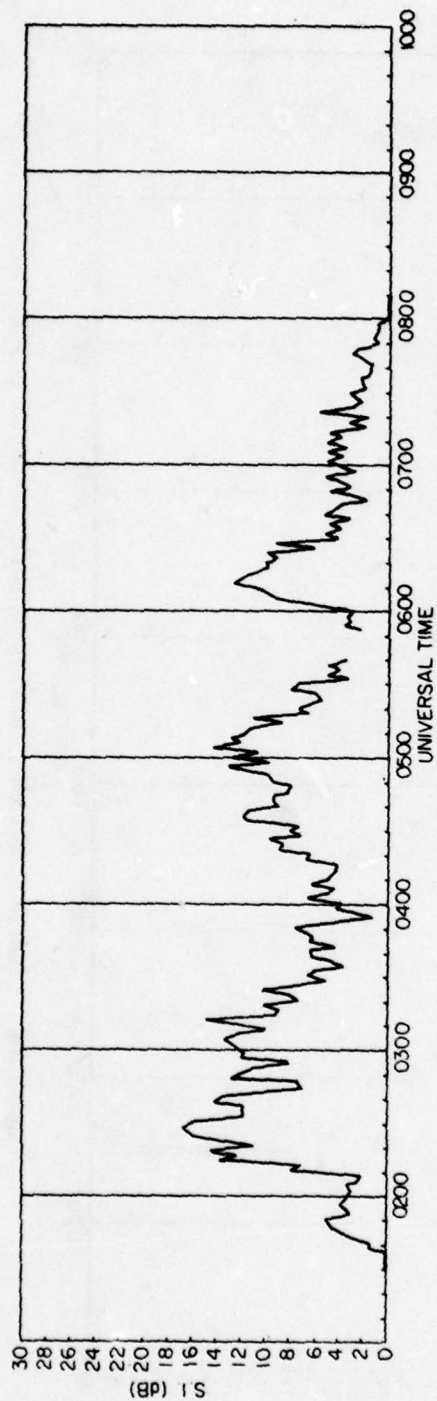


Figure 97. LES-8, 249 MHz, 8 March 1978, Ancon, Peru

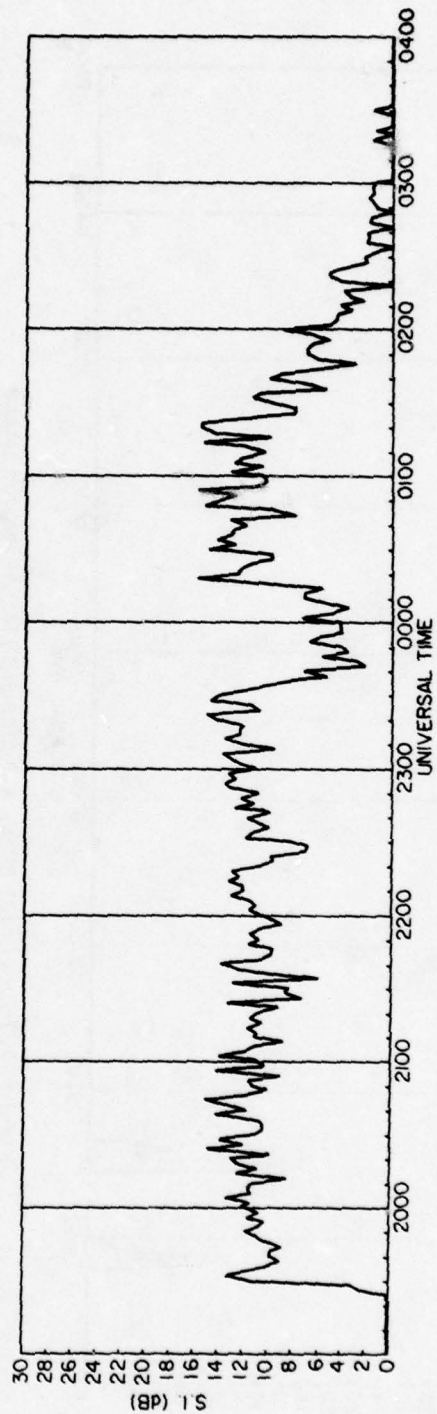


Figure 98. MARISAT, 257 MHz, 8-9 March 1978, Ghana

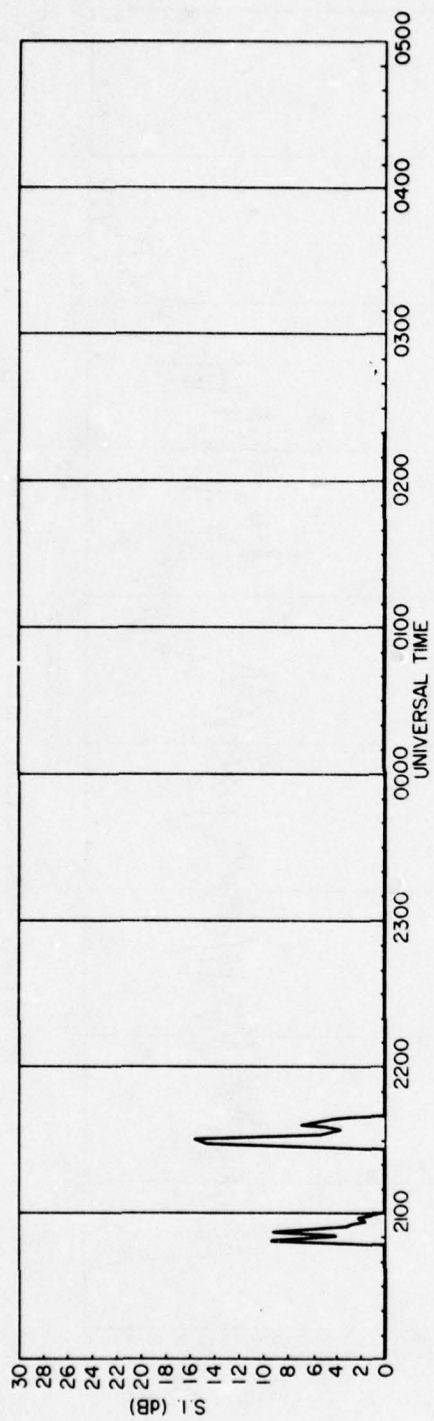


Figure 99. SIRIO, 136 MHz, 8-9 March 1978, Ascension Island

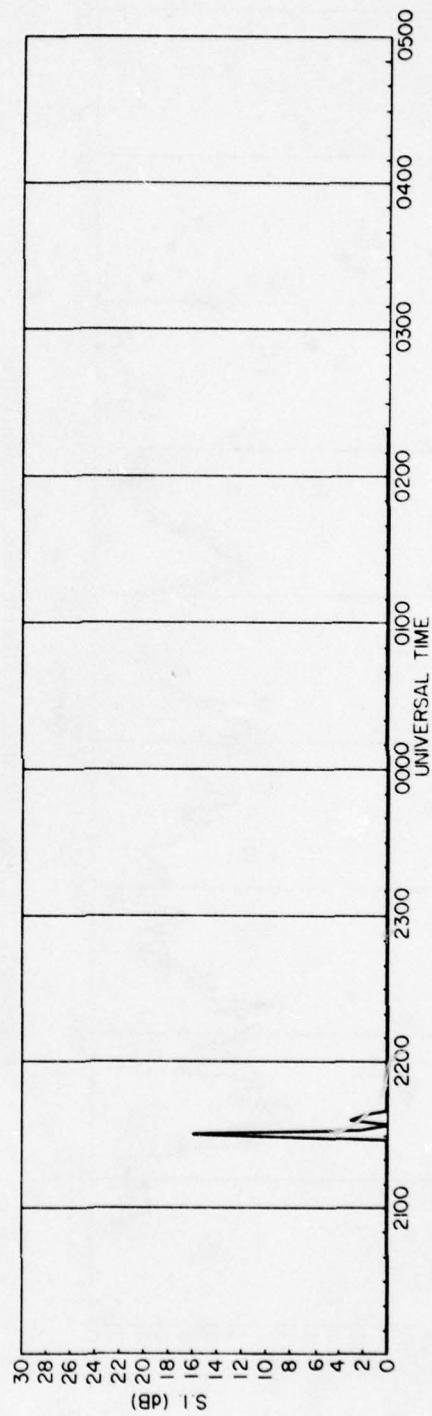


Figure 100. MARISAT, 257 MHz, 8-9 March 1978, Ascension Island

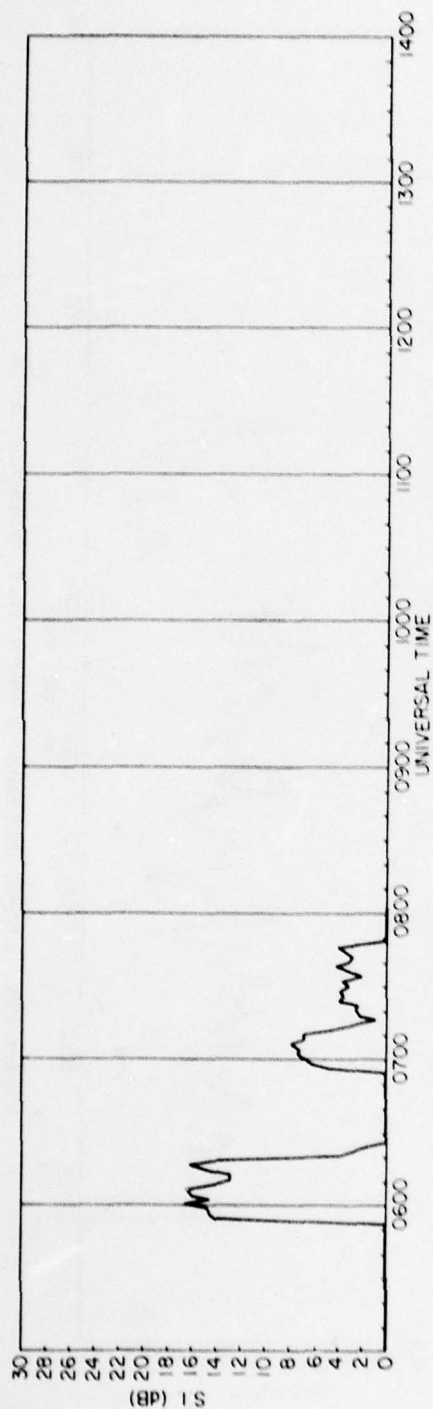


Figure 101. LES-9, 249 MHz, 9 March 1978, Natal, Brazil

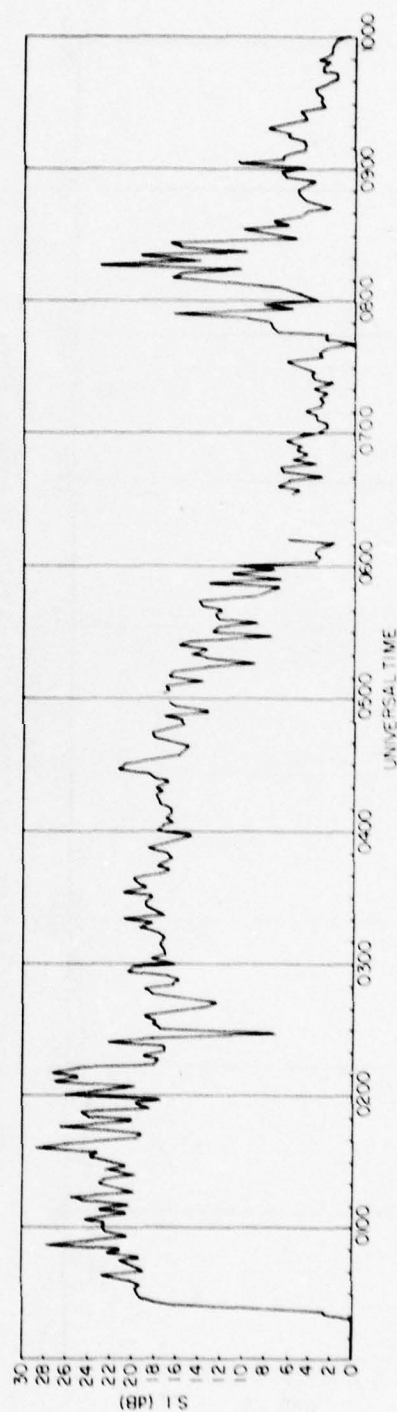


Figure 102. MARISAT, 257 MHz, 9 March 1978, Huancayo, Peru

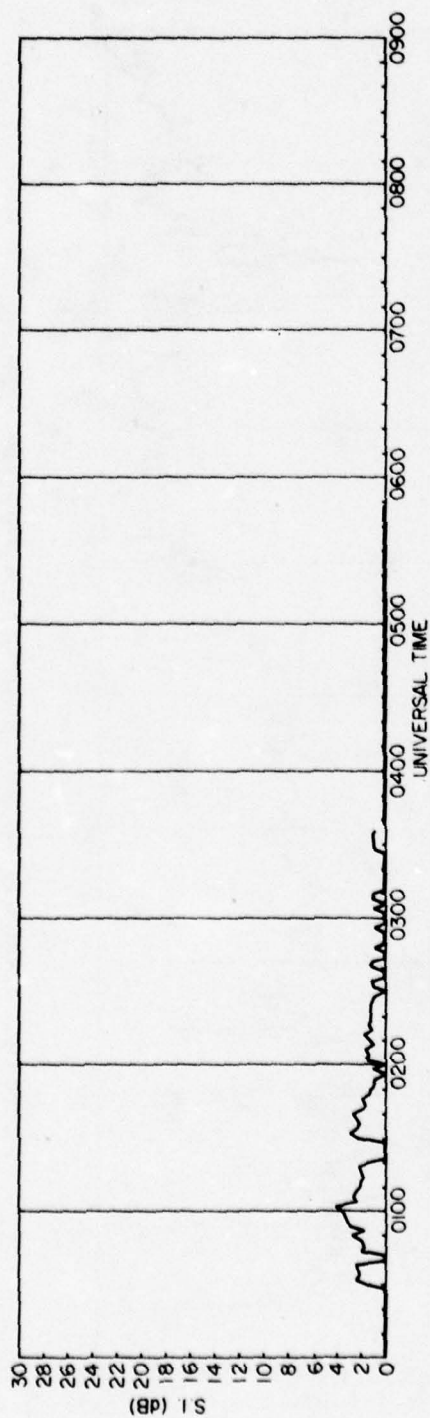


Figure 103. MARISAT, 1541 MHz, 9 March 1978, Huancayo, Peru

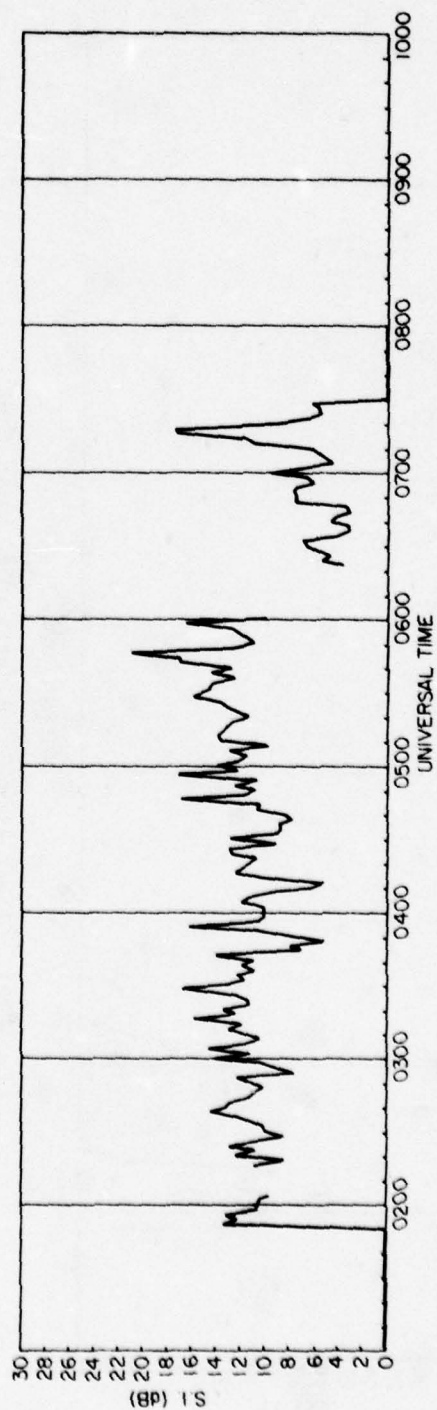


Figure 104. LES-9, 249 MHz, 9 March 1978, Huancayo, Peru

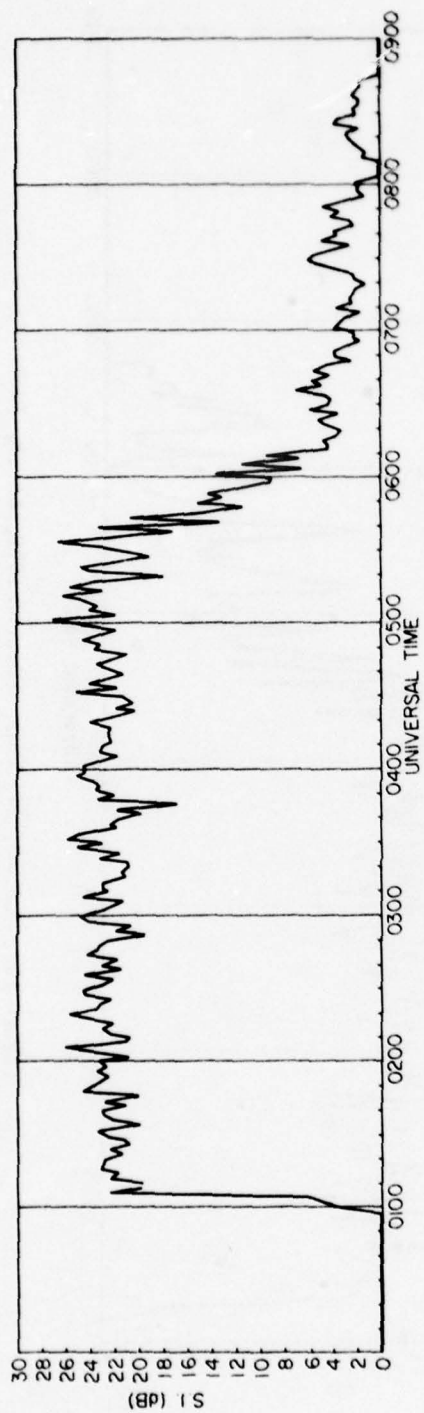


Figure 105. LES-9, 249 MHz, 9 March 1978, Ancon, Peru

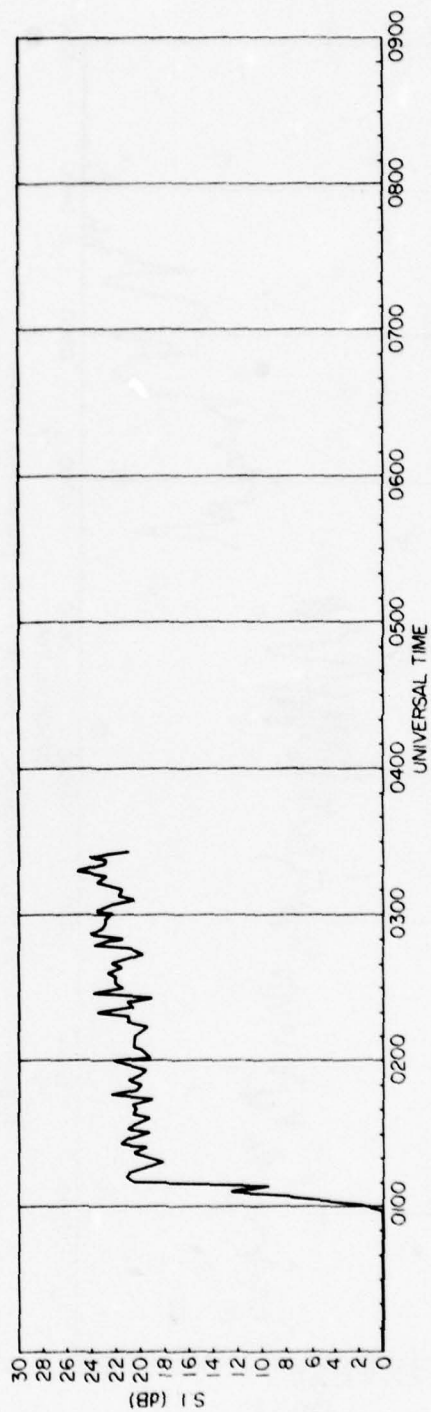


Figure 106. GOES-1, 136 MHz, 9 March 1978, Ancon, Peru

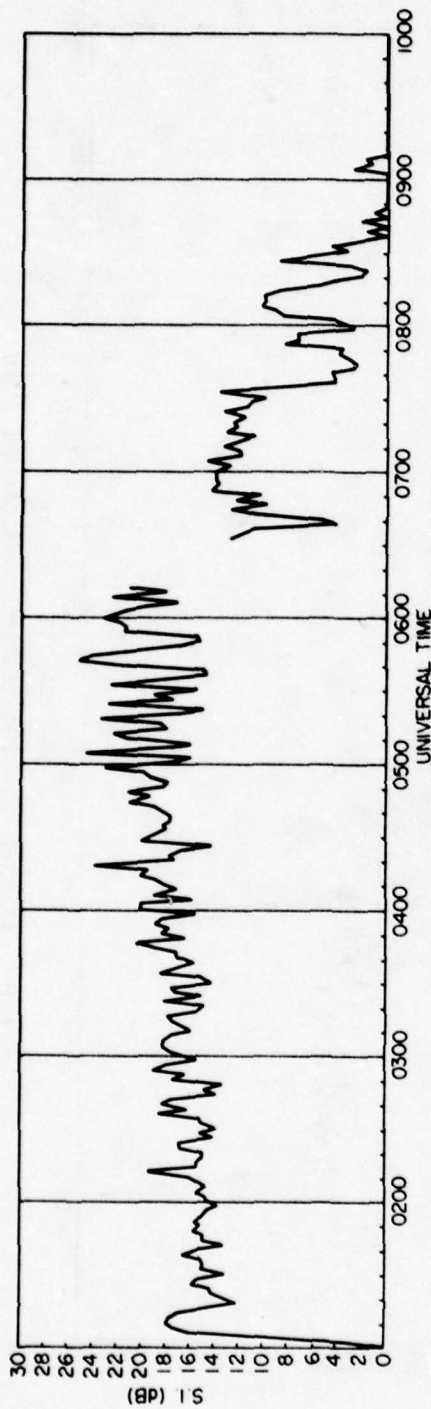


Figure 107. ATS-3, 136 MHz, 9 March 1978, Huancayo, Peru

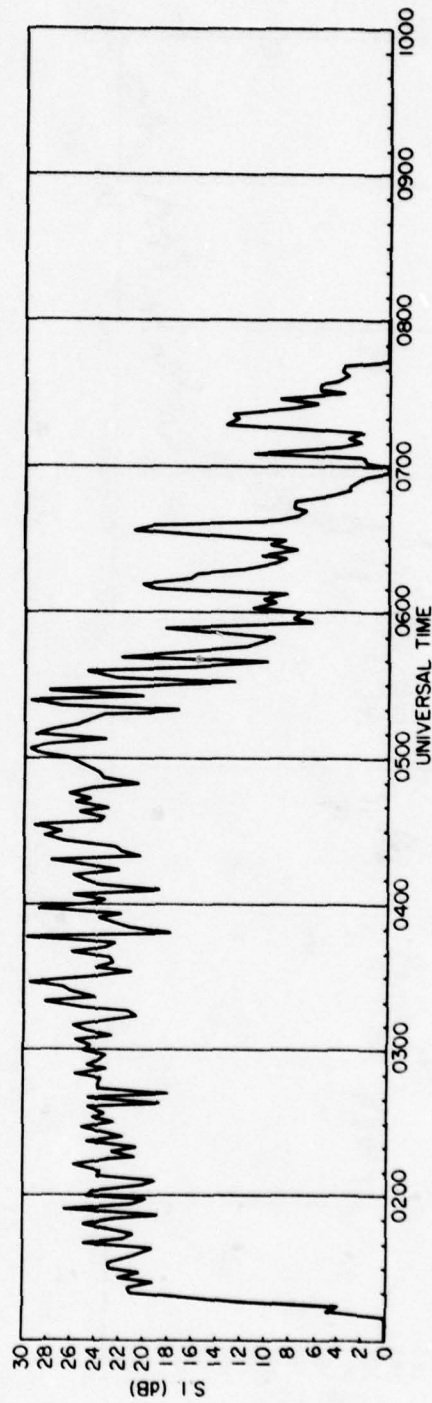


Figure 108. LES-8, 249 MHz, 9 March 1978, Ancon, Peru

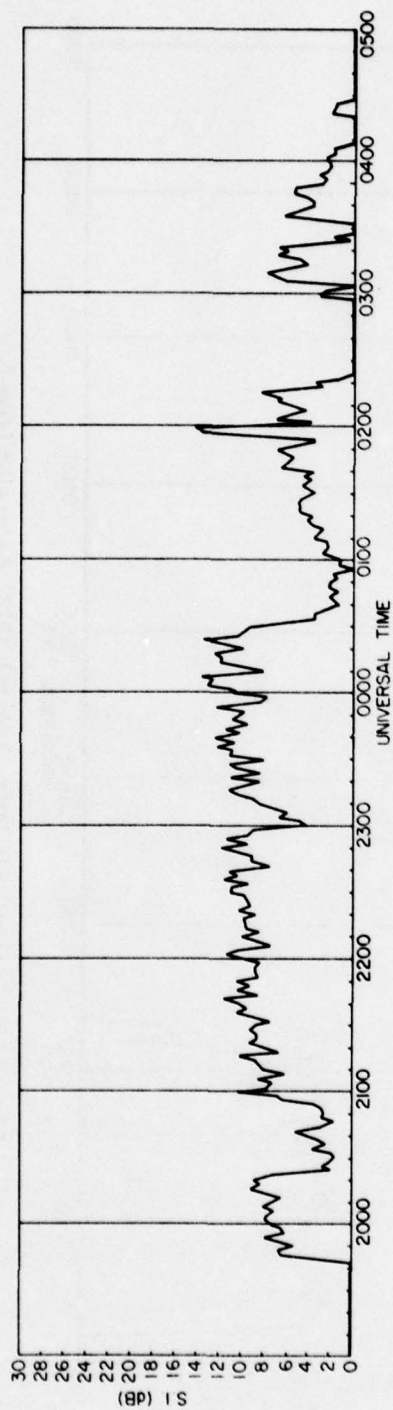


Figure 109. MARISAT, 257 MHz, 9-10 March 1978, Ghana

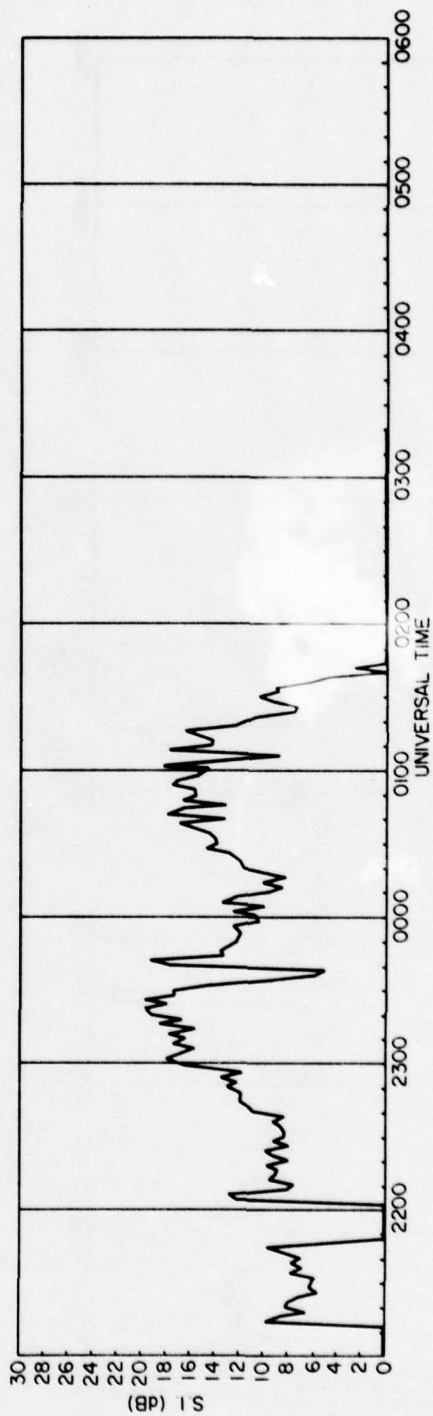


Figure 110. SIRIO, 136 MHz, 9-10 March 1978, Ascension Island

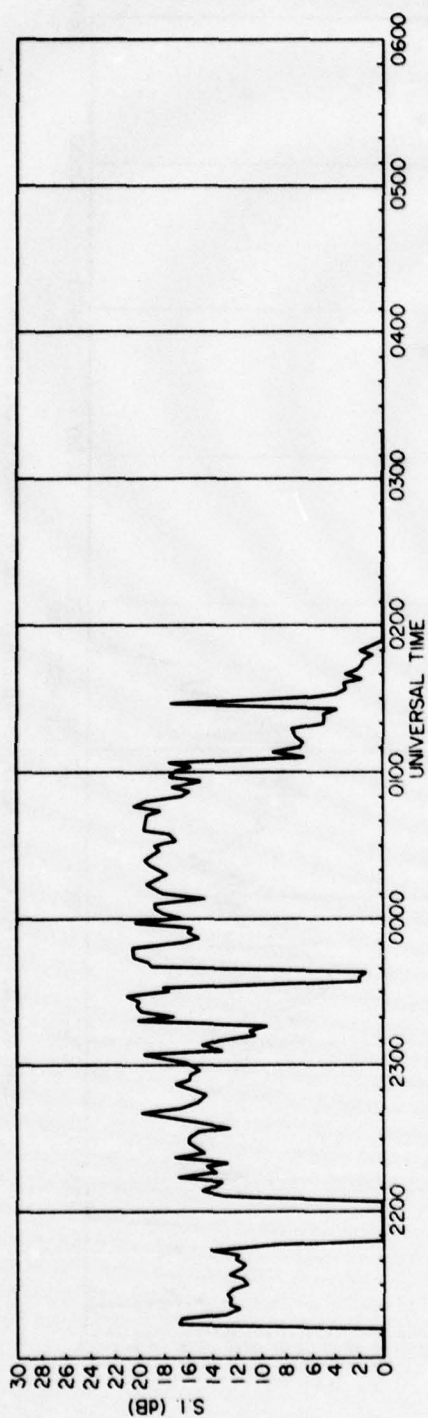


Figure 111. MARISAT, 257 MHz, 9-10 March 1978, Ascension Island

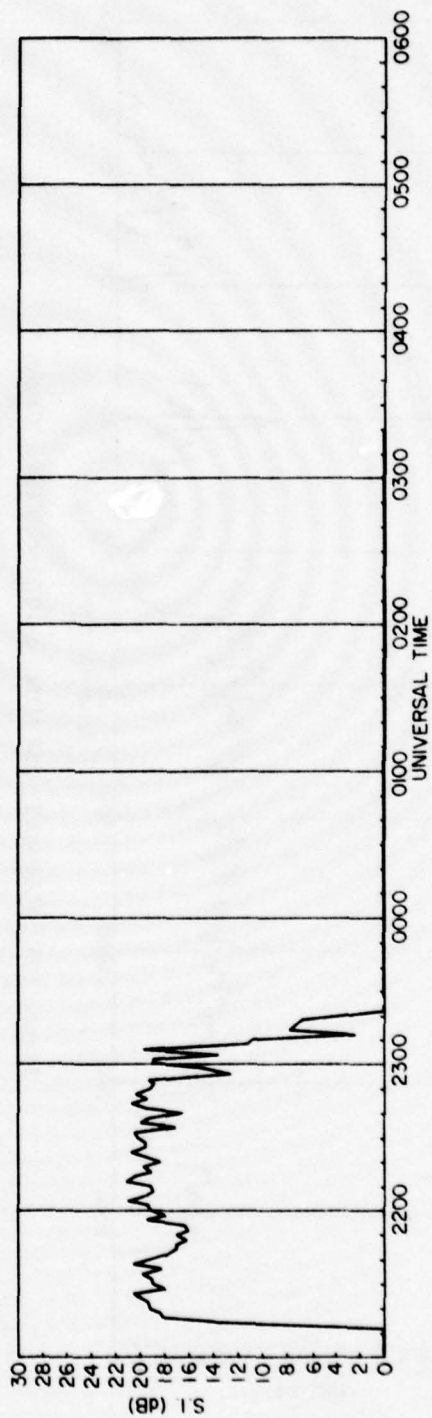


Figure 112. LES-9, 249 MHz, 9 March 1978, Ascension Island

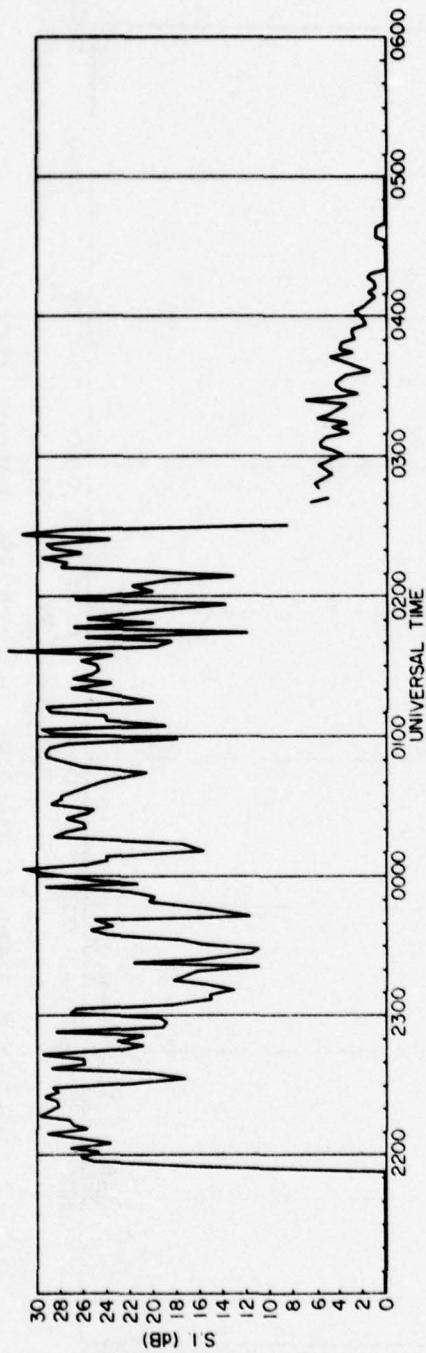


Figure 113. MARISAT, 257 MHz, 9-10 March 1978, Natal, Brazil

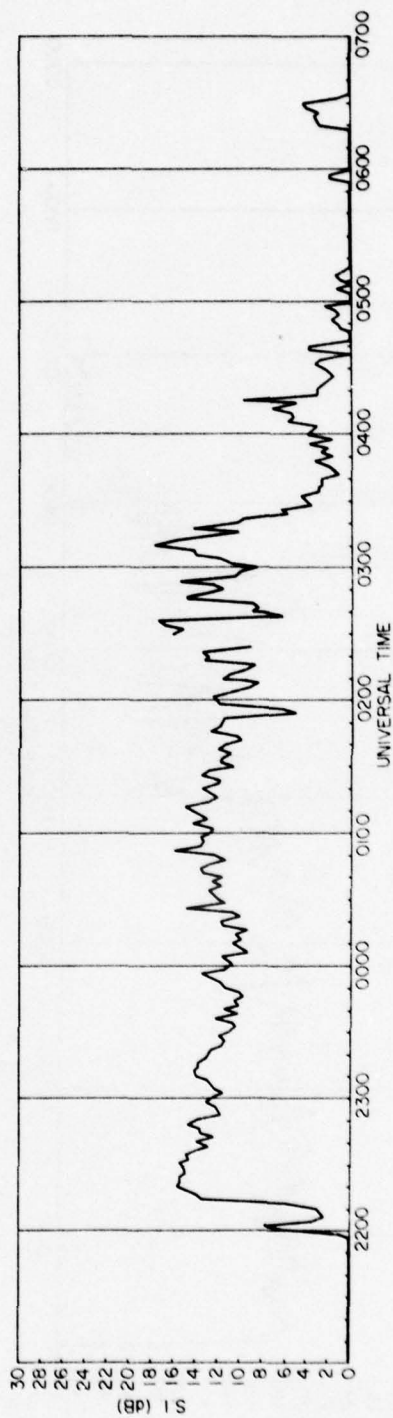


Figure 114. LES-9, 249 MHz, 9-10 March 1978, Natal, Brazil

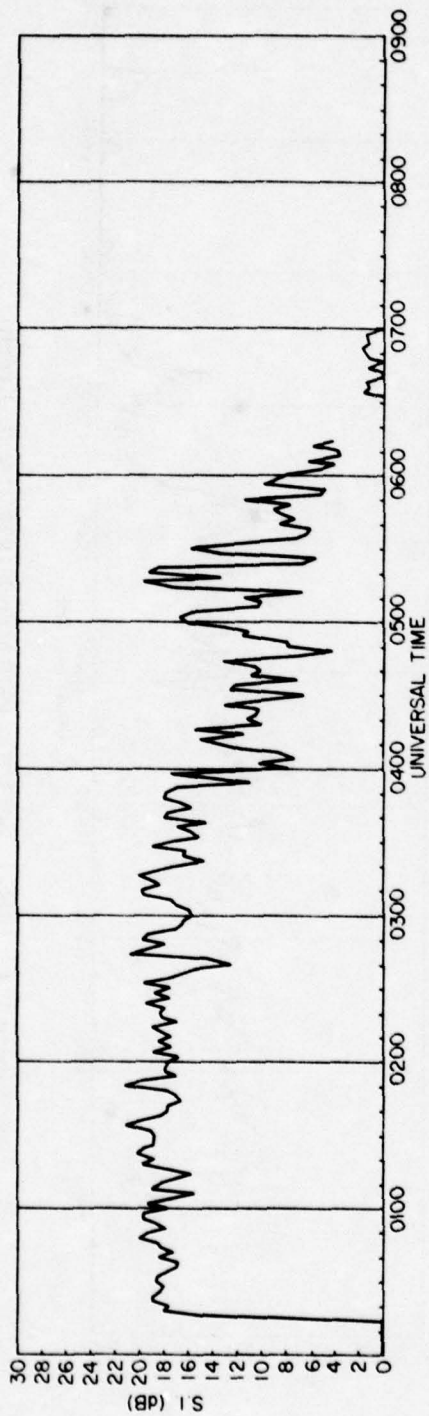


Figure 115. MARISAT, 257 MHz, 10 March 1978, Huancayo, Peru

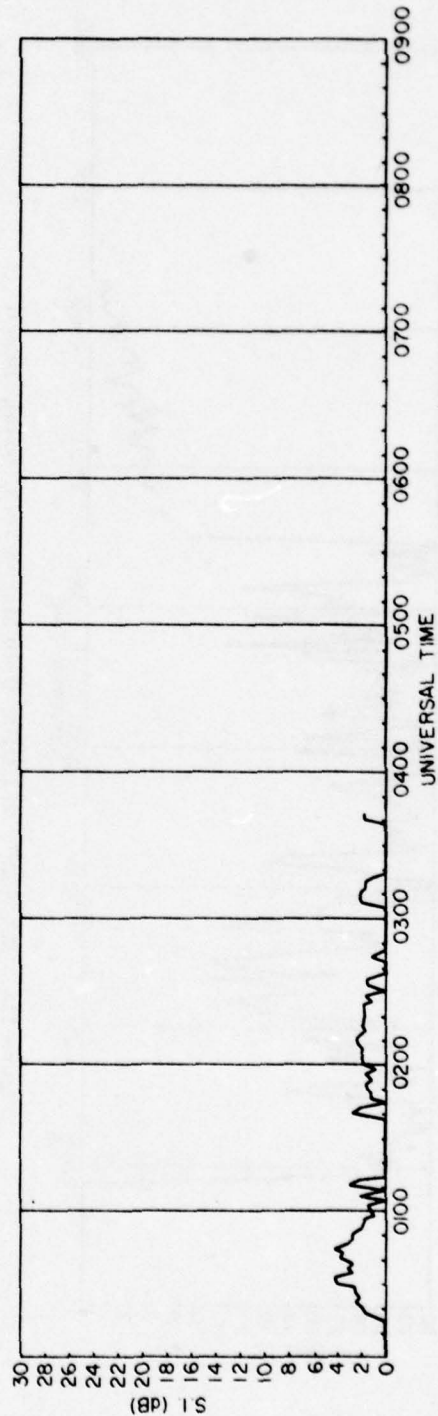


Figure 116. MARISAT, 1541 MHz, 10 March 1978, Huancayo, Peru

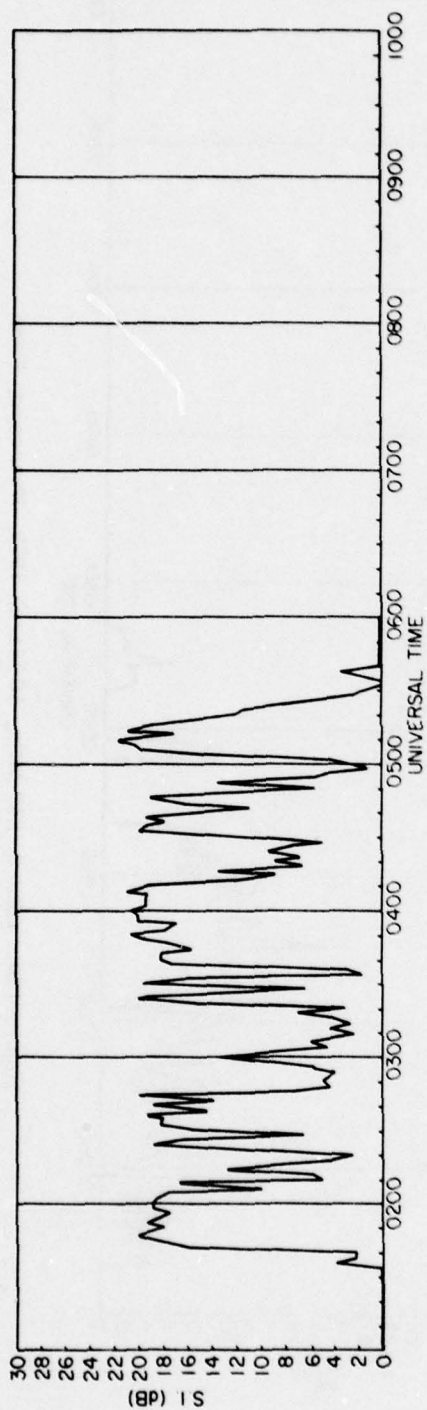


Figure 117. LES-9, 249 MHz, 10 March 1978, Ancon, Peru

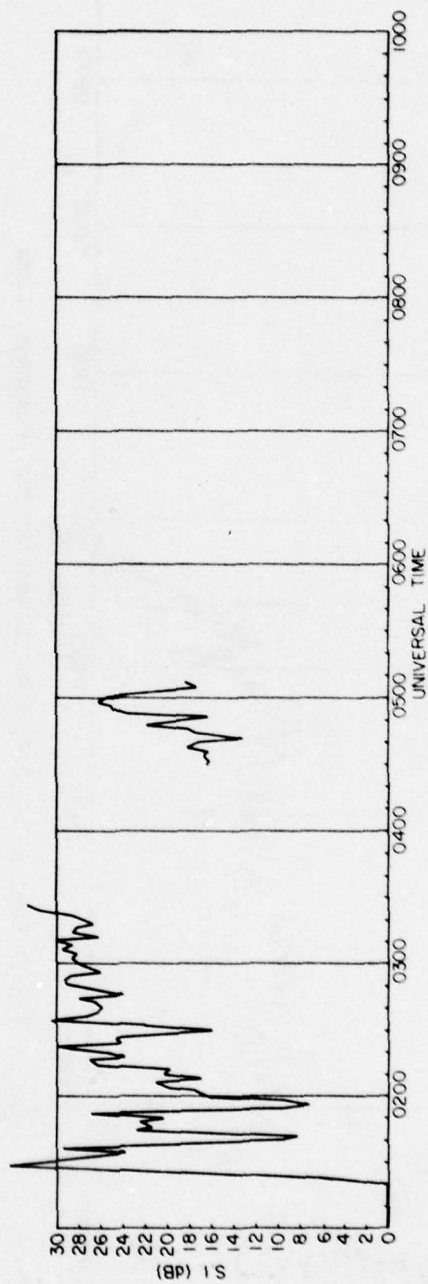


Figure 118. GOES, 136 MHz, 10 March 1978, Ancon, Peru

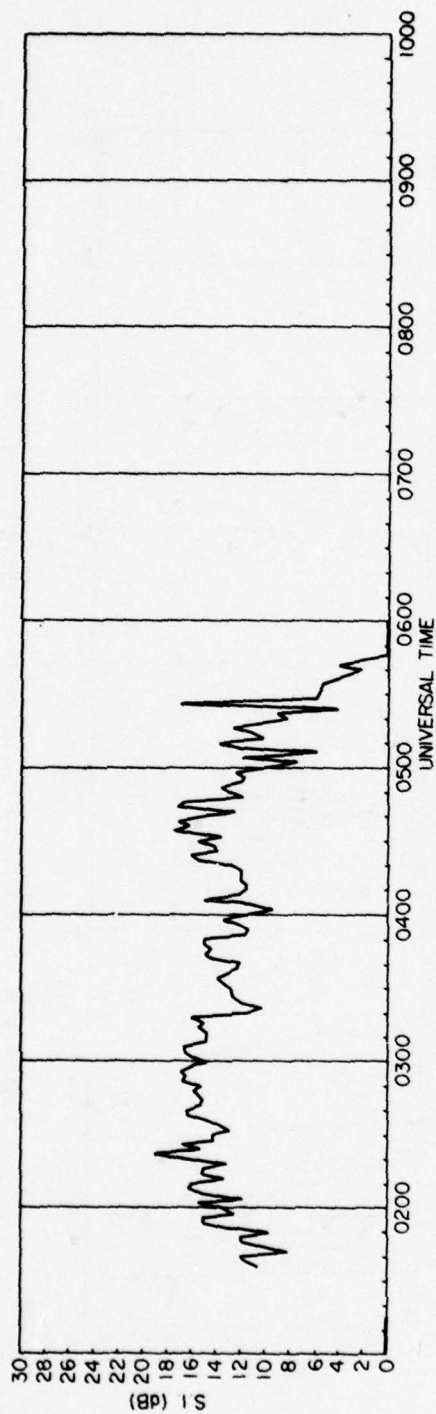


Figure 119. ATS-3, 136 MHz, 10 March 1978, Huancayo, Peru

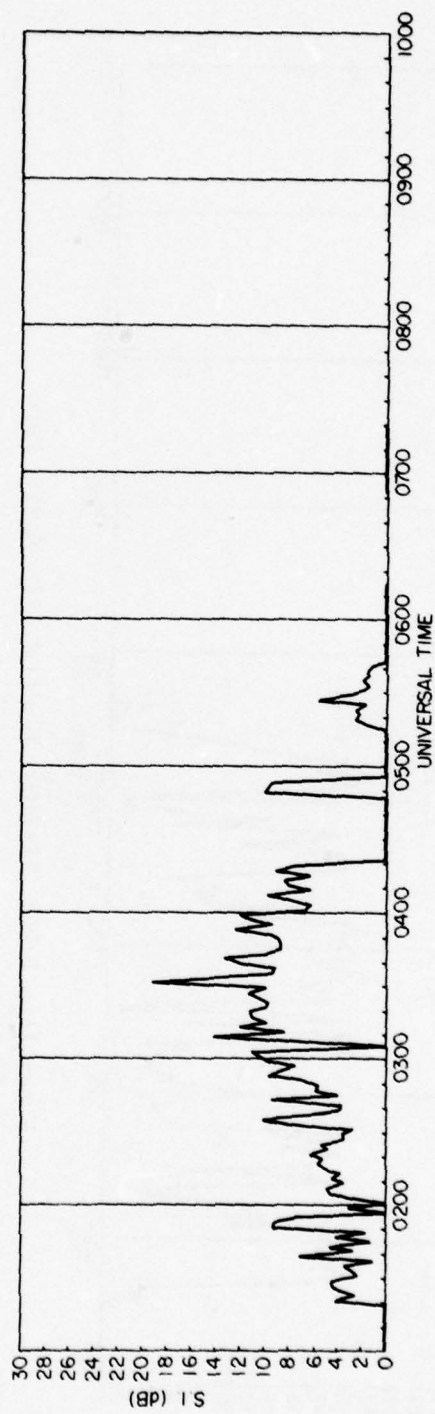


Figure 120. LES-8, 249 MHz, 10 March 1978, Huancayo, Peru

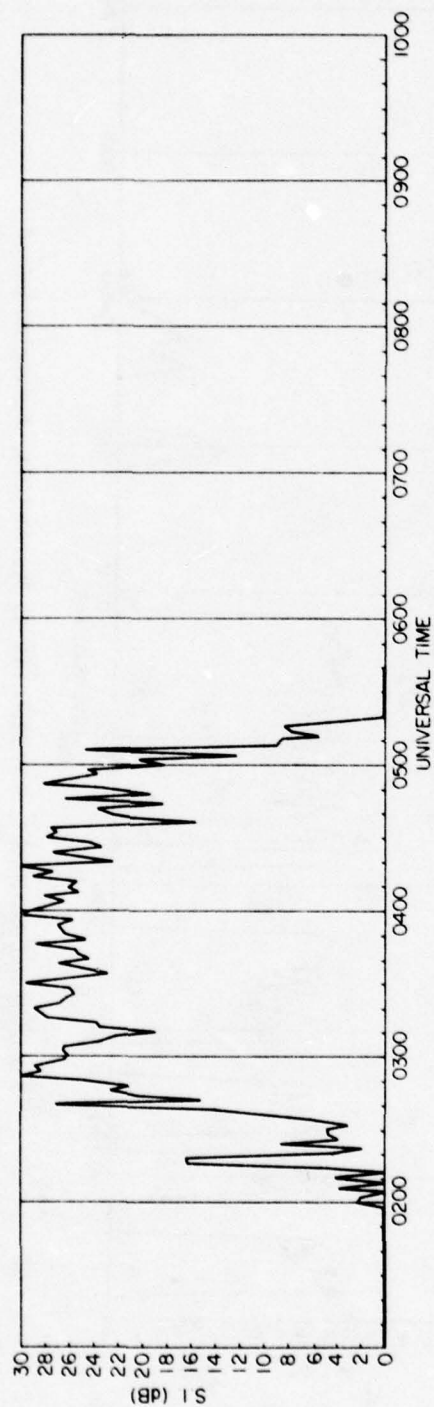


Figure 121. LES-8, 249 MHz, 10 March 1978, Ancon, Peru

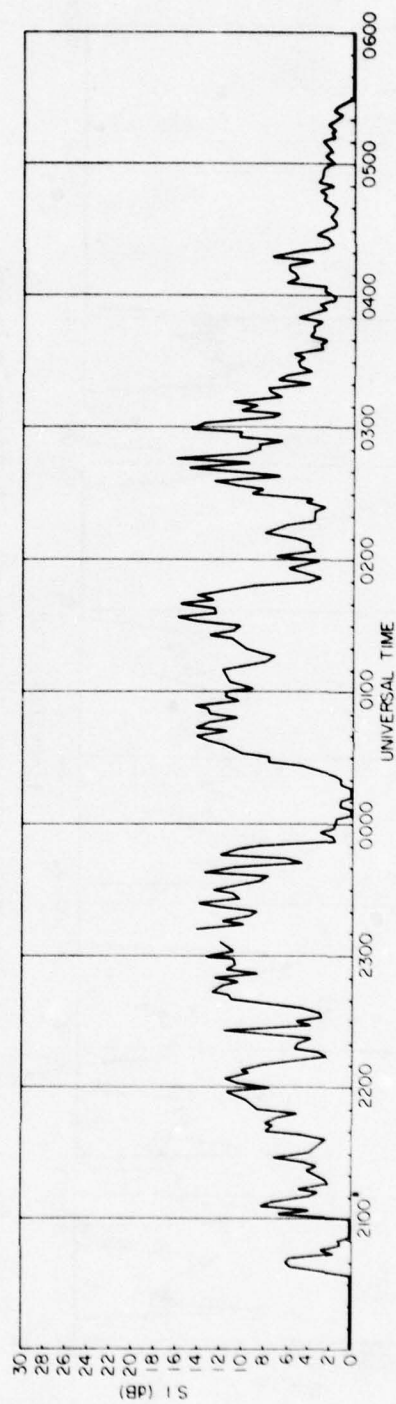


Figure 122. MARISAT, 257 MHz, 10-11 March 1978, Ghana

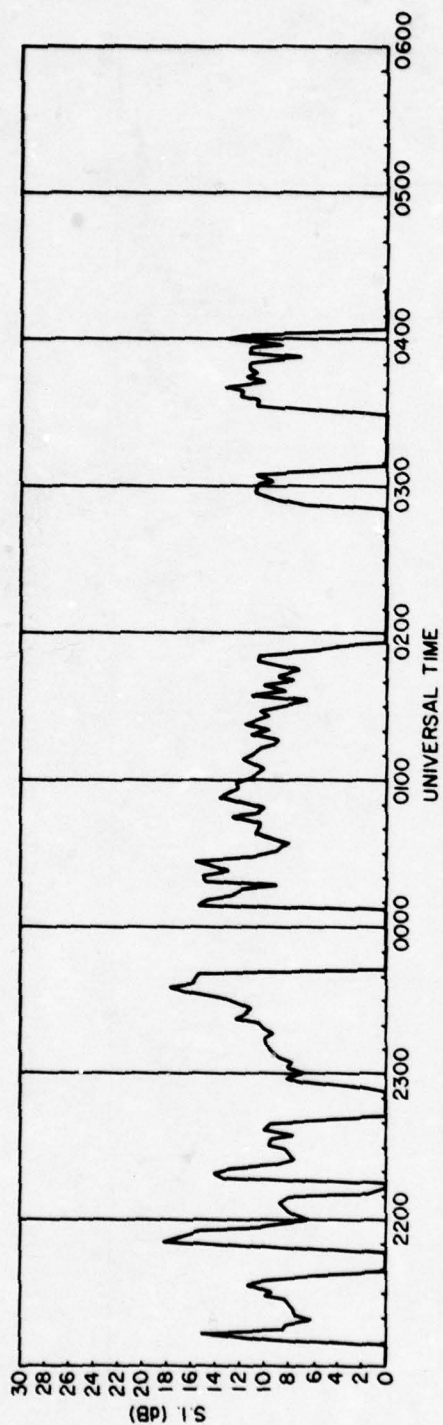


Figure 123. SIRIO, 136 MHz, 10-11 March 1978, Ascension Island

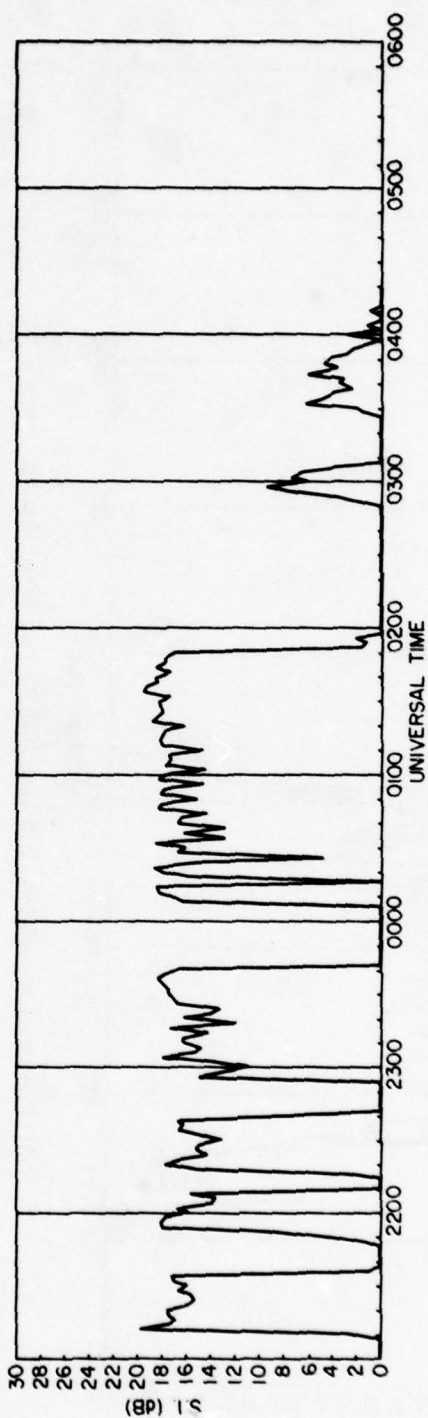


Figure 124. MARISAT, 257 MHz, 10-11 March 1978, Ascension Island

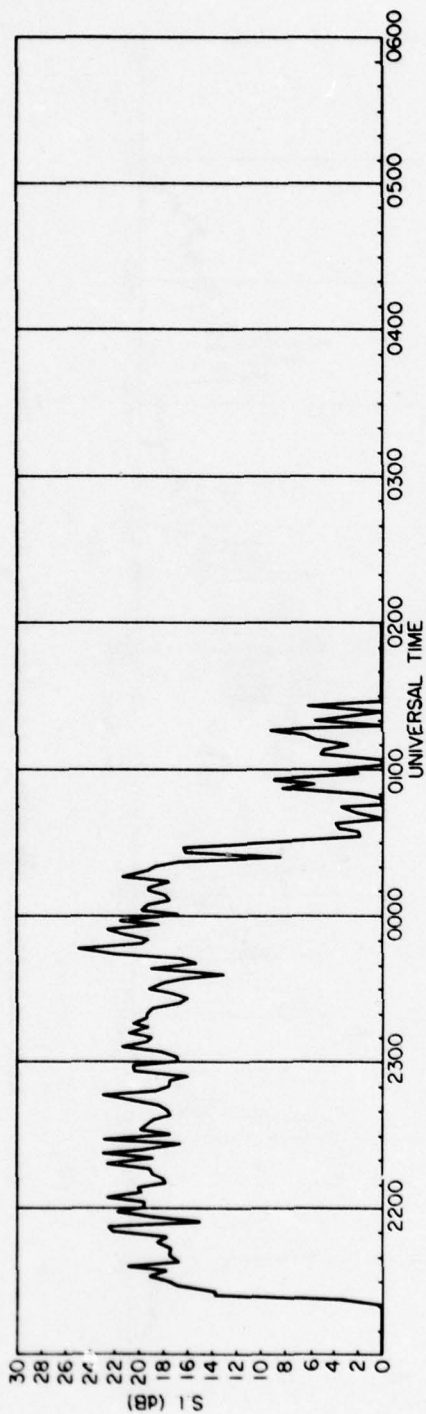


Figure 125. LES-9, 249 MHz, 10-11 March 1978, Ascension Island

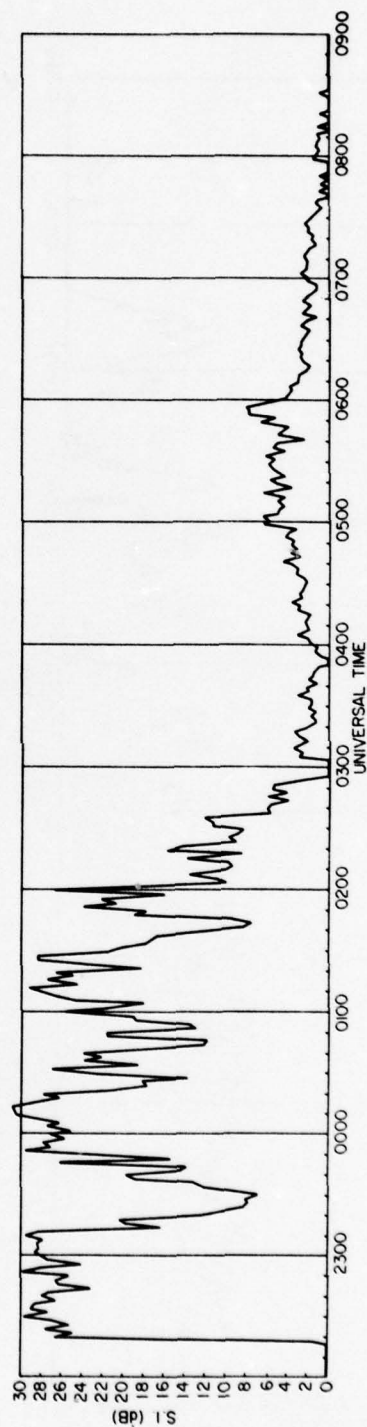


Figure 126. MARISAT, 257 MHz, 10-11 March 1978, Natal, Brazil

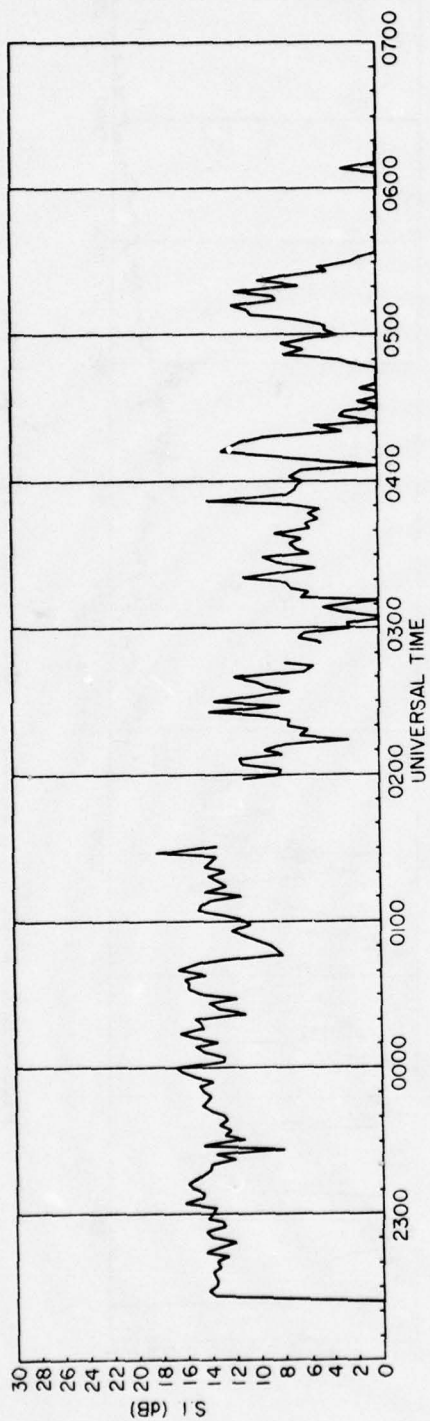


Figure 127. LES-9, 249 MHz, 10-11 March 1978, Natal, Brazil

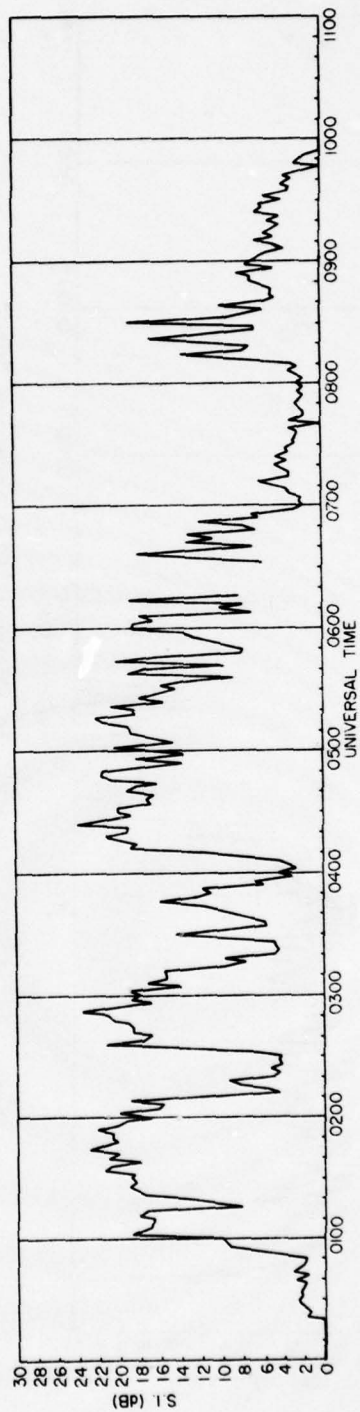


Figure 128. MARISAT, 257 MHz, 11 March 1978, Huancayo, Peru

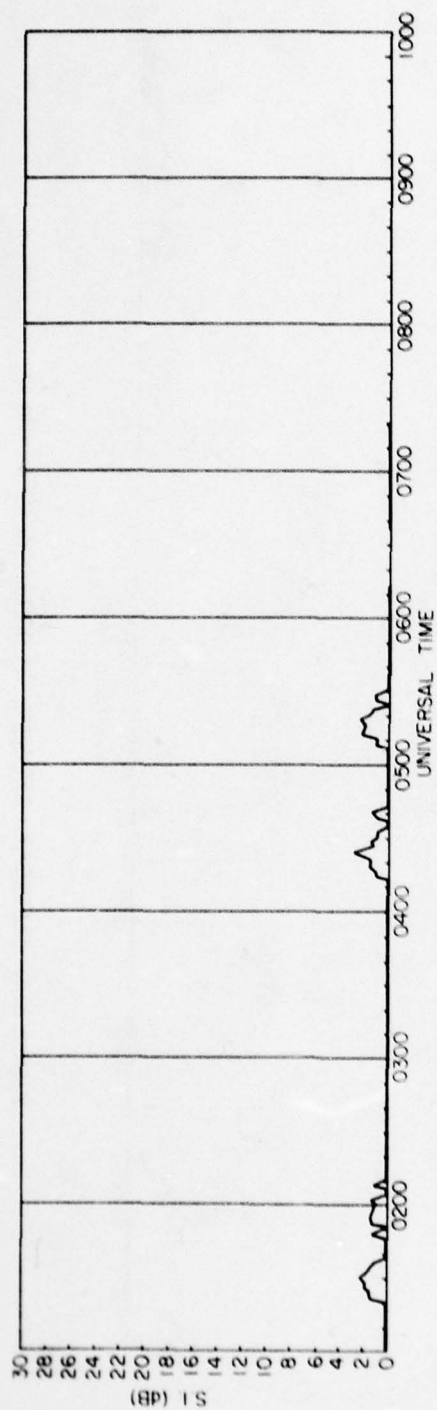


Figure 129. MARISAT, 1541 MHz, 11 March 1978, Huancayo, Peru

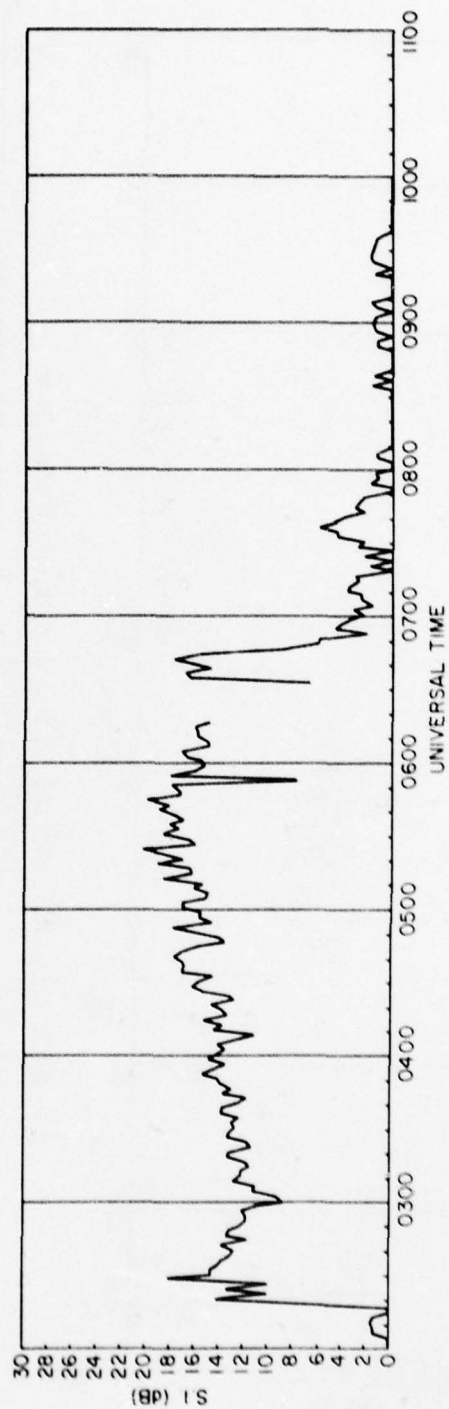


Figure 130. ATS-3, 136 MHz, 11 March 1978, Huancayo, Peru

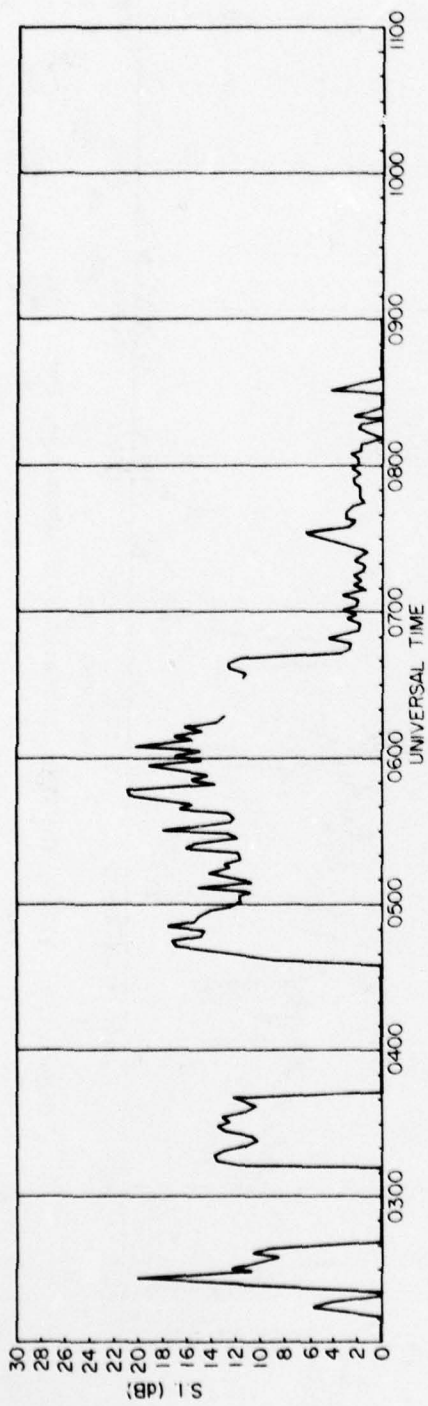


Figure 131. LES-8, 249 MHz, 11 March 1978, Huancayo, Peru

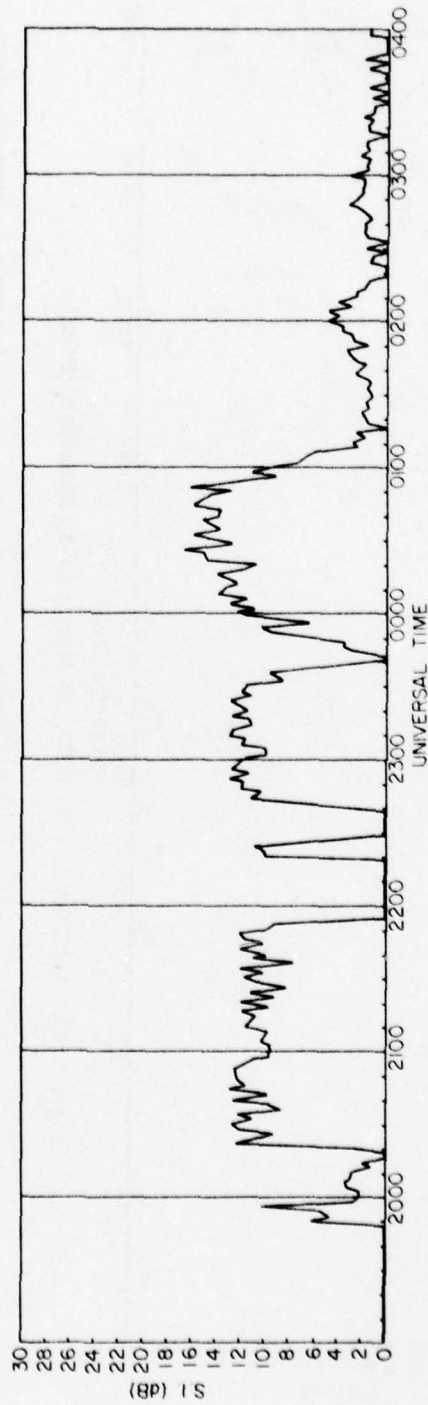


Figure 132. MARISAT, 257 MHz, 11-12 March 1978, Ghana

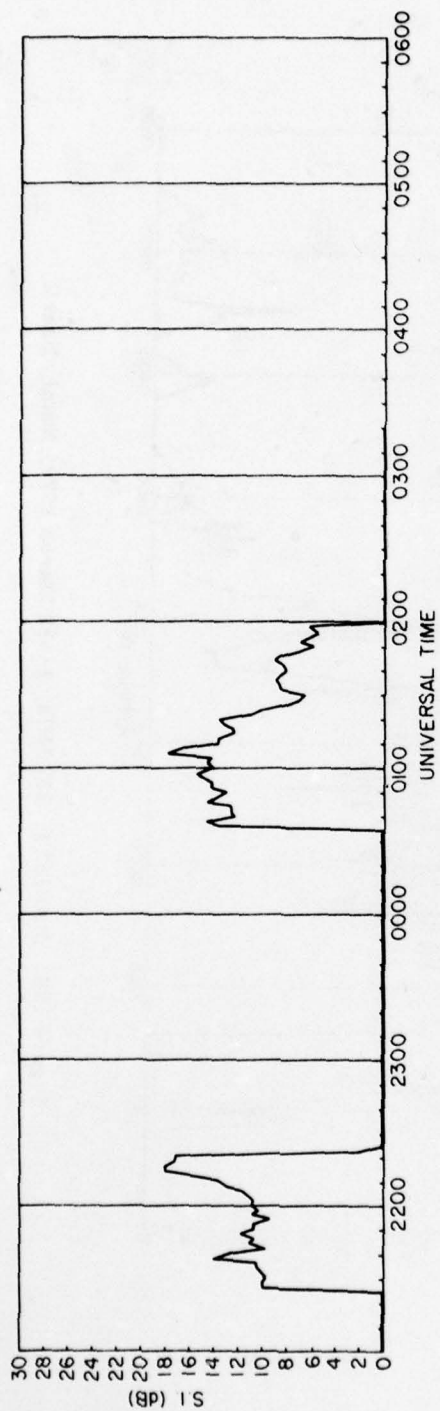


Figure 133. SIRIO, 136 MHz, 11-12 March 1978, Ascension Island

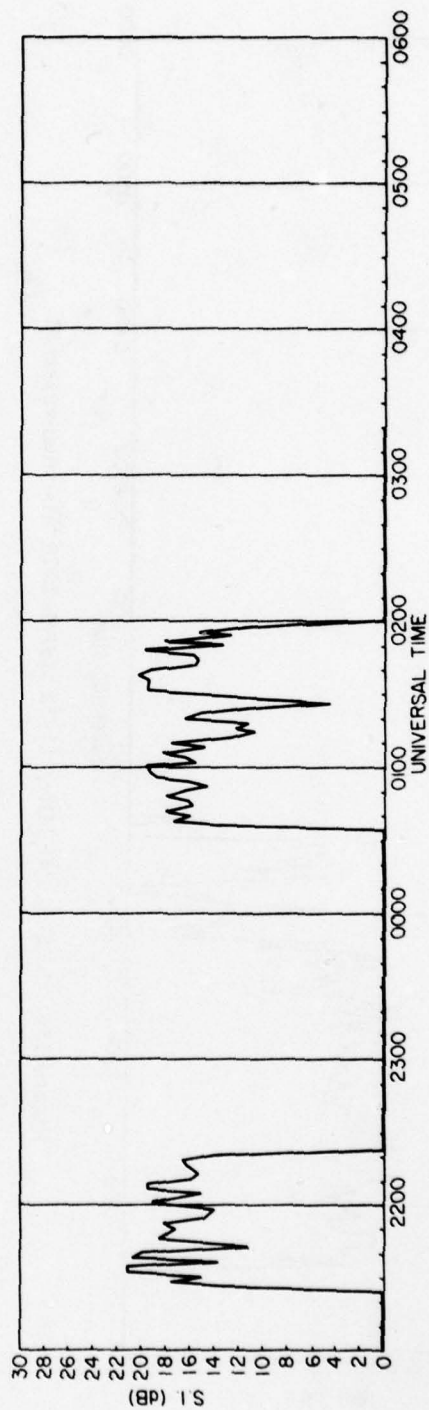


Figure 134. MARISAT, 257 MHz, 11-12 March 1978, Ascension Island

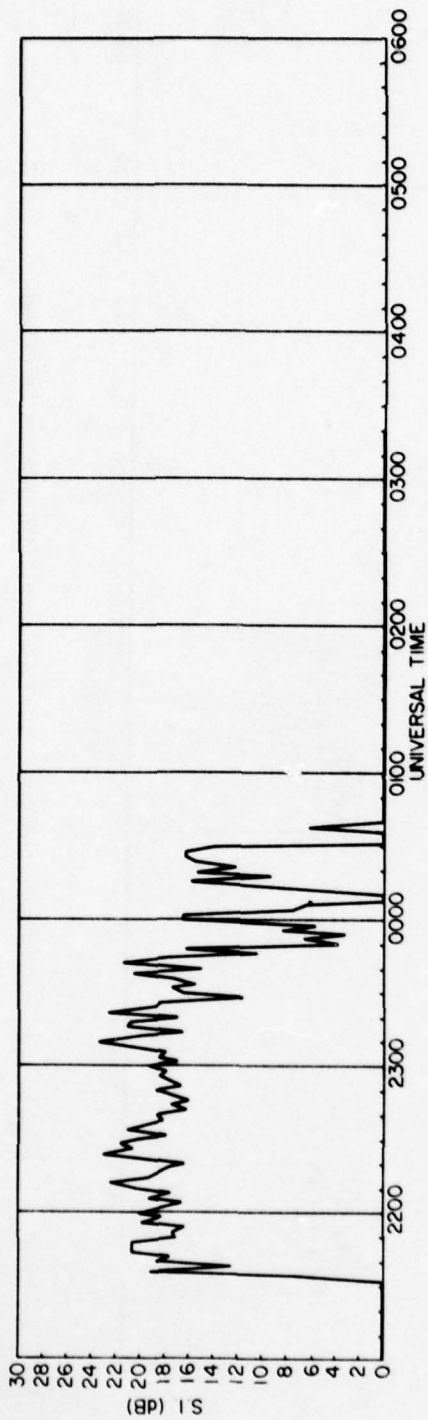


Figure 135. LES-9, 249 MHz, 11-12 March 1978, Ascension Island

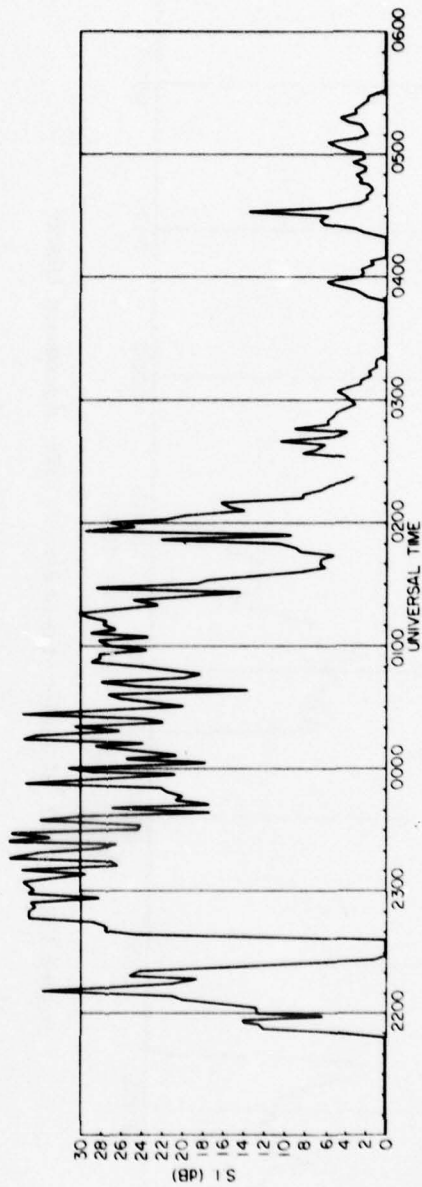


Figure 136. MARISAT, 257 MHz, 11-12 March 1978, Natal, Brazil

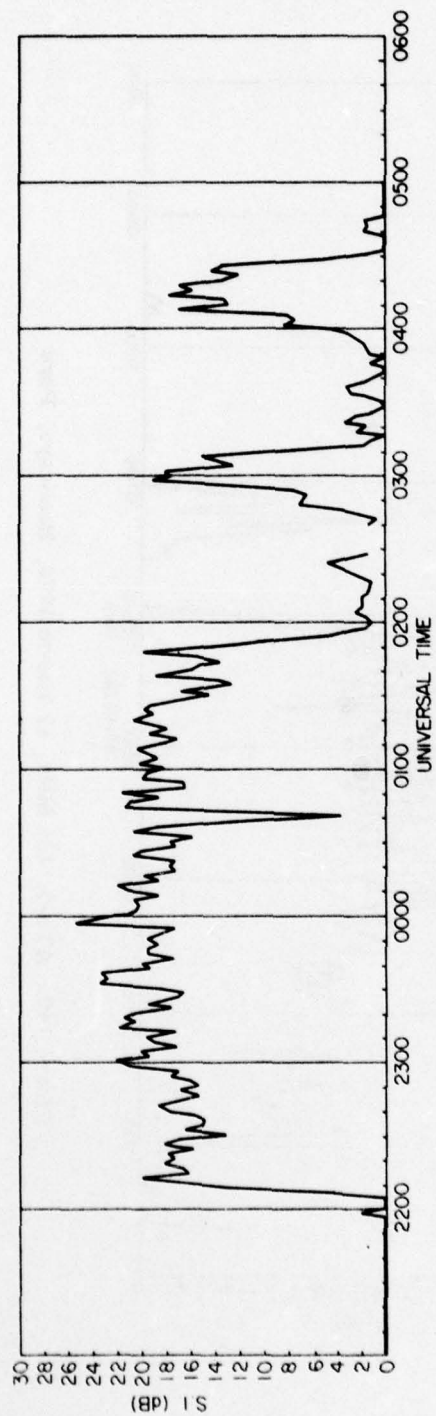


Figure 137. LES-9, 249 MHz, 11-12 March 1978, Natal, Brazil

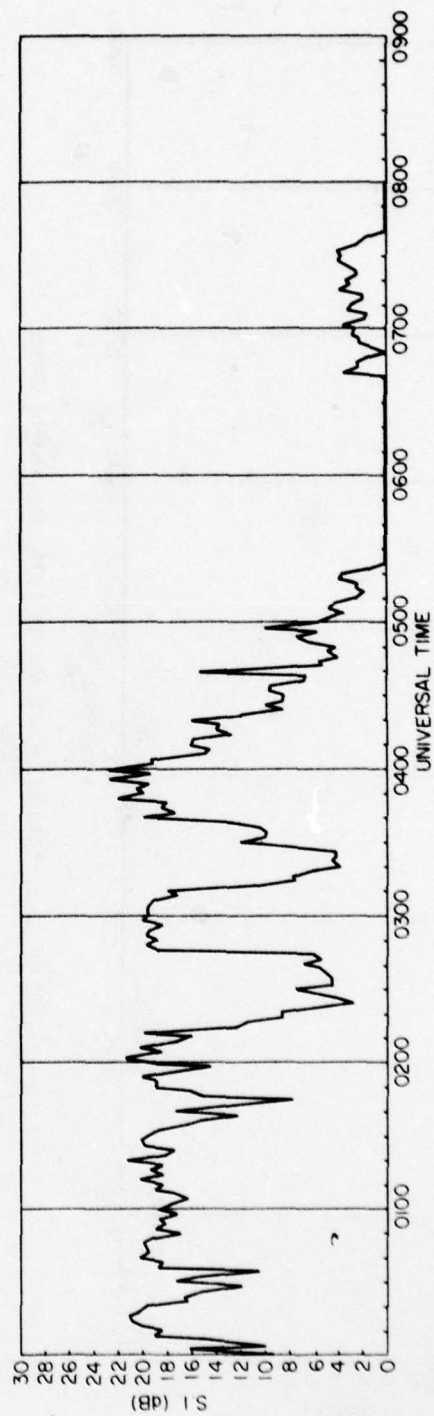


Figure 138. MARISAT, 257 MHz, 12 March 1978, Huancayo, Peru

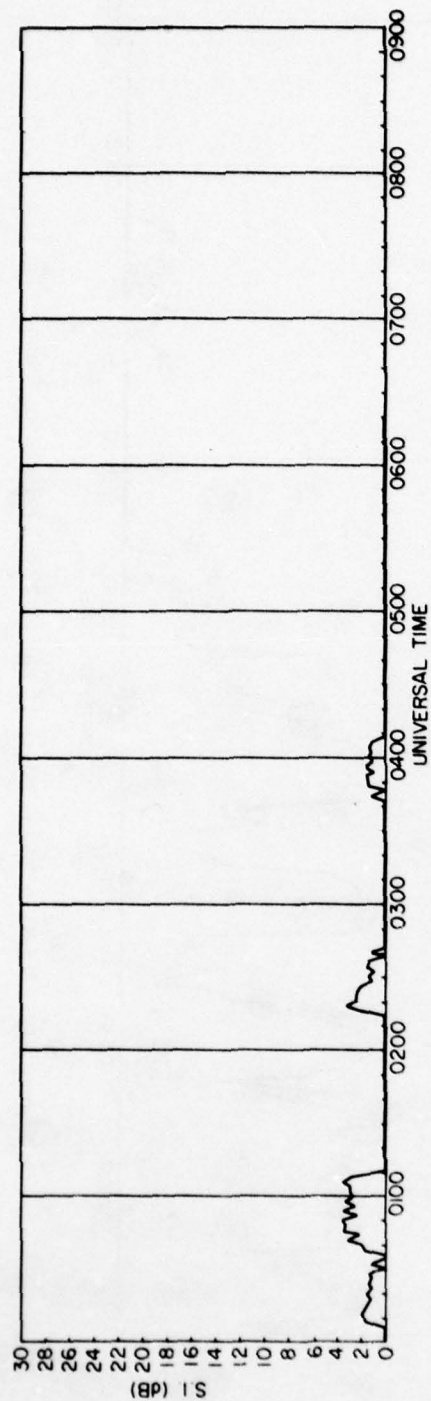


Figure 139. MARISAT, 1541 MHz, 12 March 1978, Huancayo, Peru

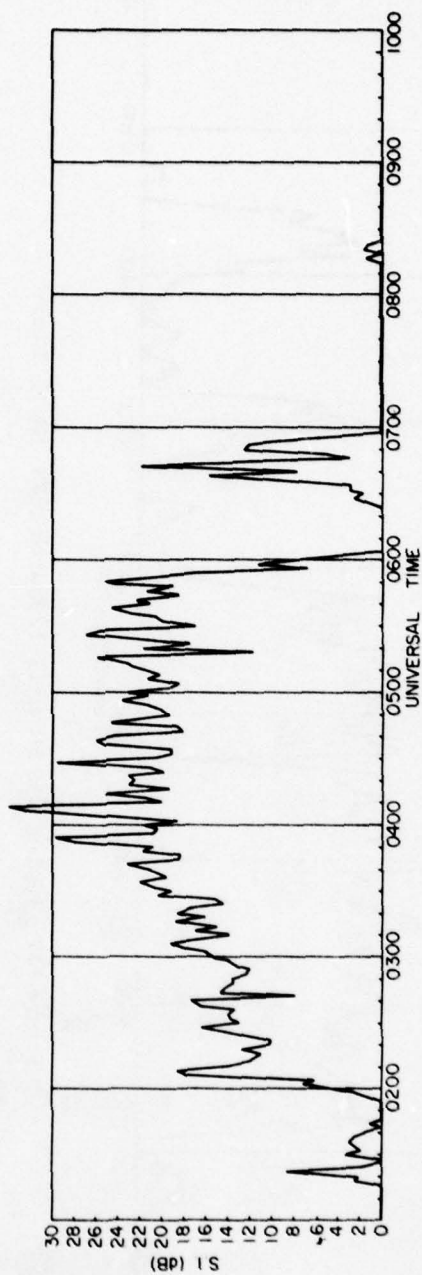


Figure 140. ATS-3, 136 MHz, 12 March 1978, Huancayo, Peru

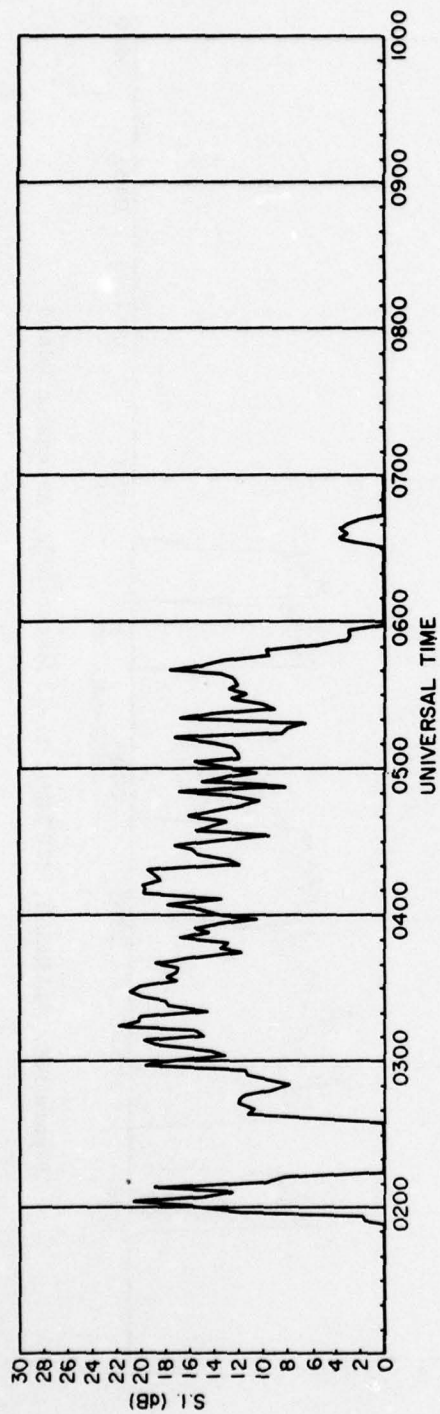


Figure 141. LES-8, 249 MHz, 12 March 1978, Huancayo, Peru

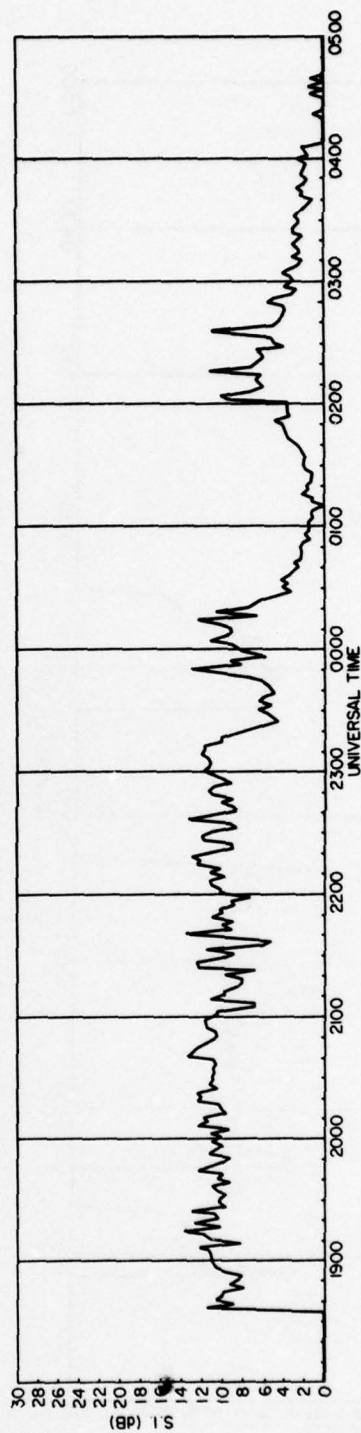


Figure 142. MARISAT, 257 MHz, 12-13 March 1978, Ghana

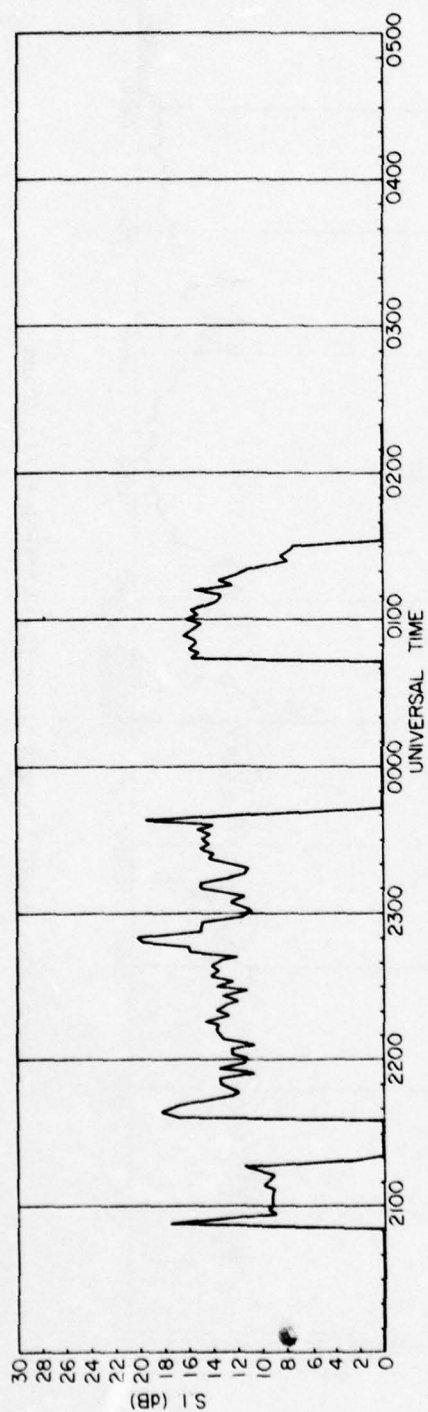


Figure 143. SIRIO, 136 MHz, 12-13 March 1978, Ascension Island

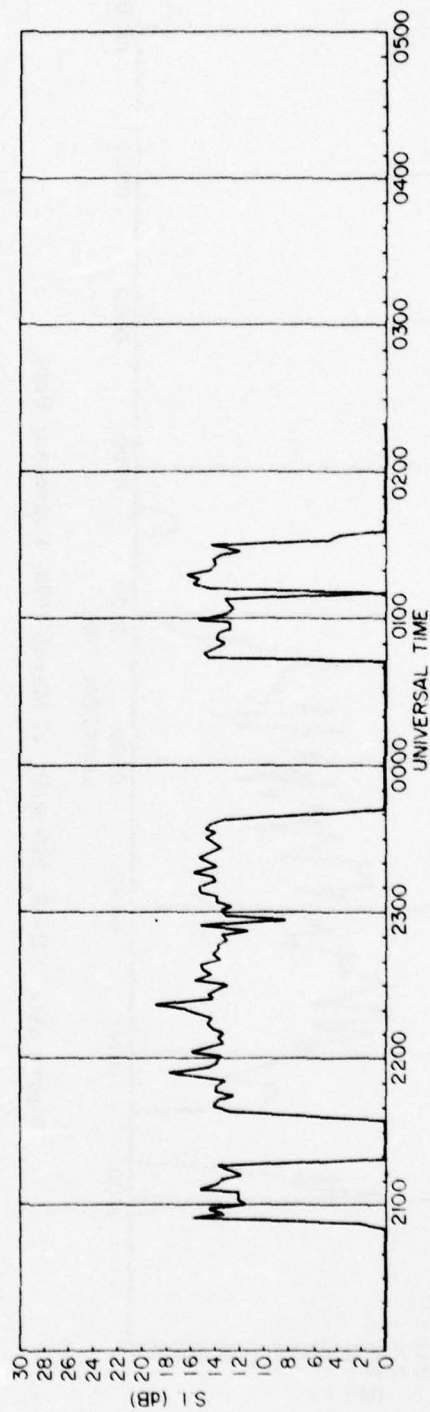


Figure 144. MARISAT, 257 MHz, 12-13 March 1978, Ascension Island

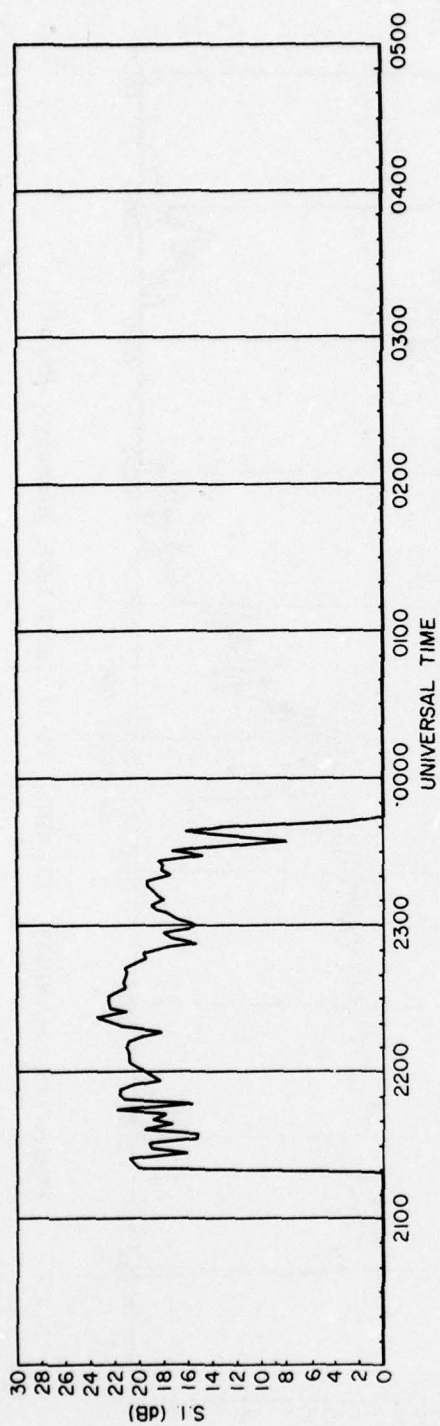


Figure 145. LES-9, 249 MHz, 12-13 March 1978, Ascension Island

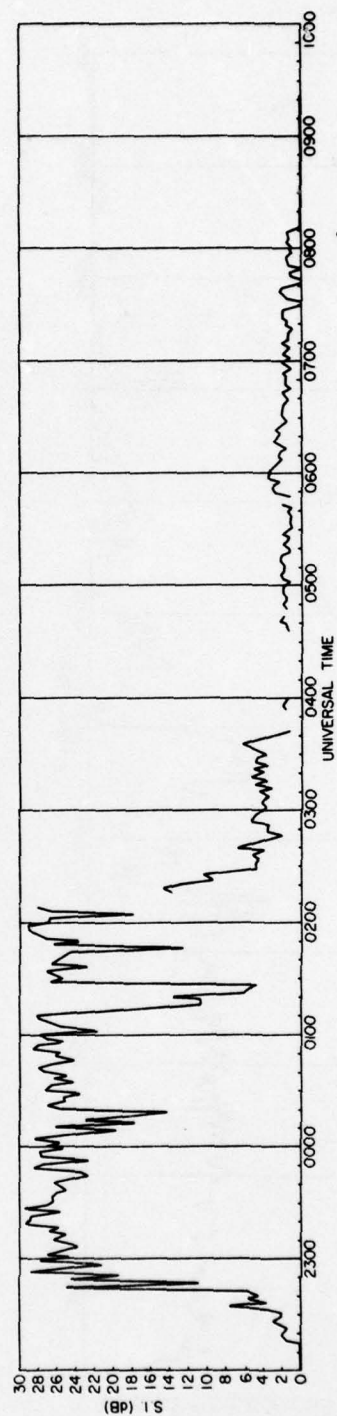


Figure 146. MARISAT, 257 MHz, 12-13 March 1978, Natal, Brazil

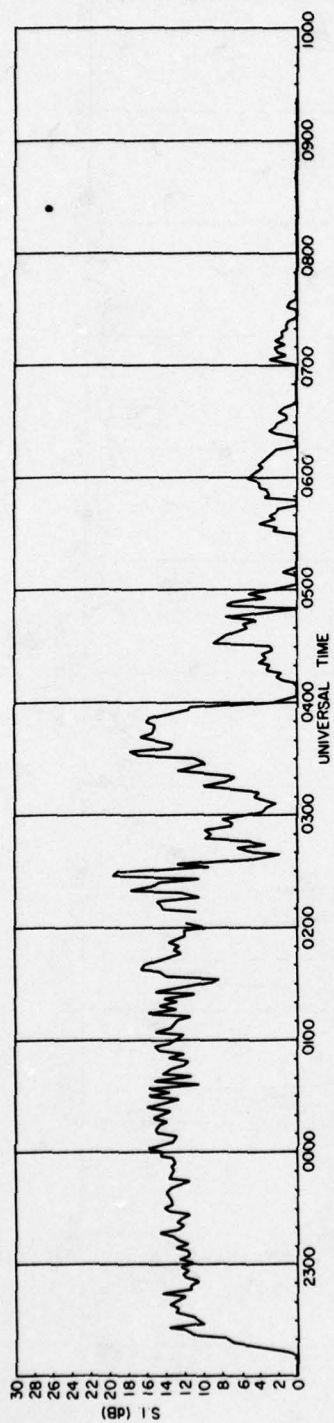


Figure 147. LES-9, 249 MHz, 12-13 March 1978, Natal, Brazil

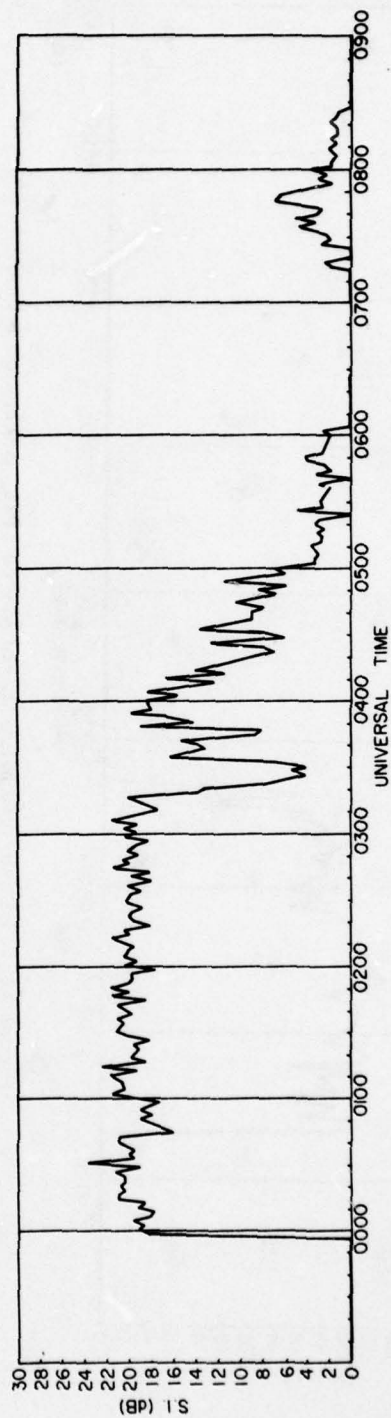


Figure 148. MARISAT, 257 MHz, 12-13 March 1978, Huancayo, Peru

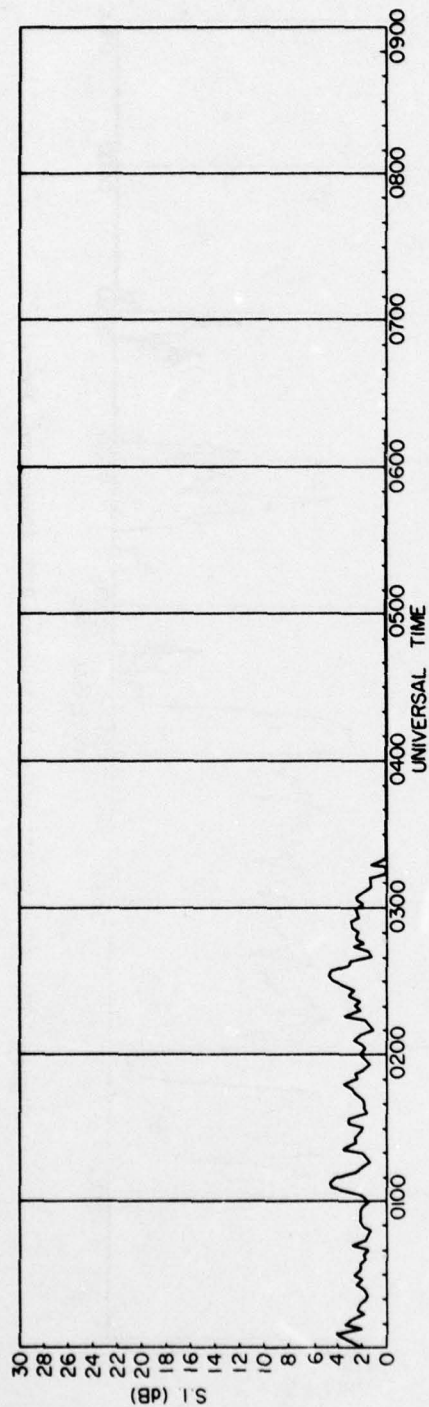


Figure 149. MARISAT, 1541 MHz, 13 March 1978, Huancayo, Peru

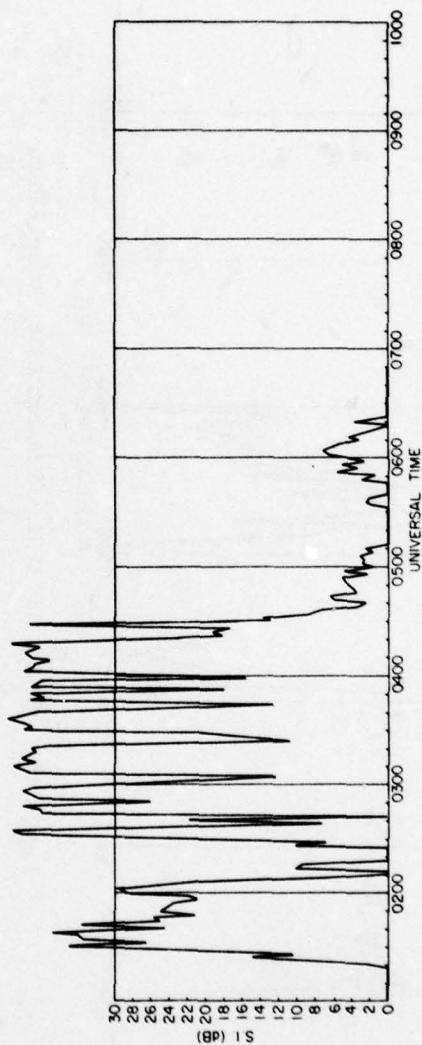


Figure 150. LES-9, 249 MHz, 13 March 1978, Ancon, Peru

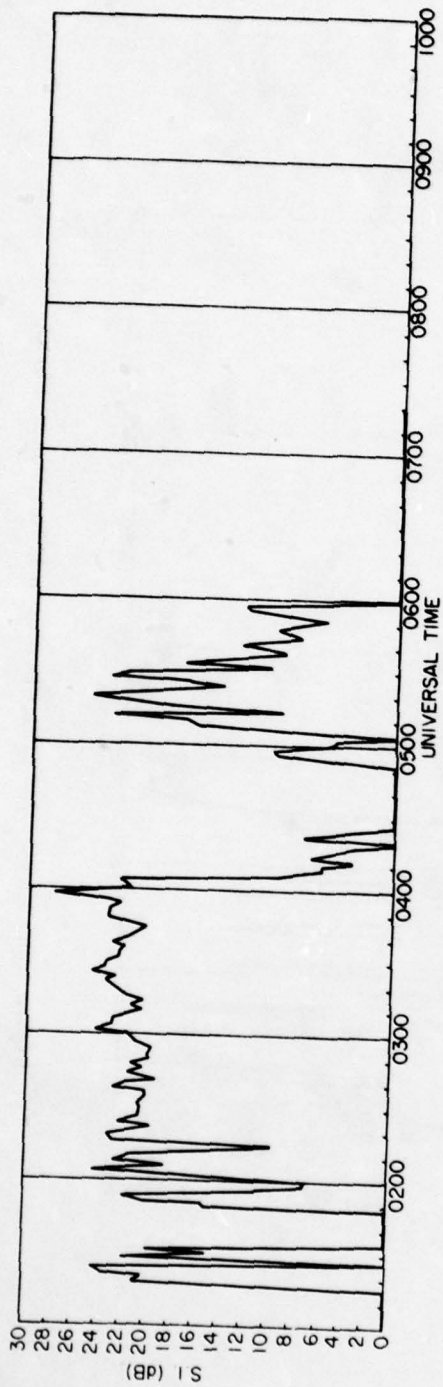


Figure 151. GOES, 136 MHz, 13 March 1978, Ancon, Peru

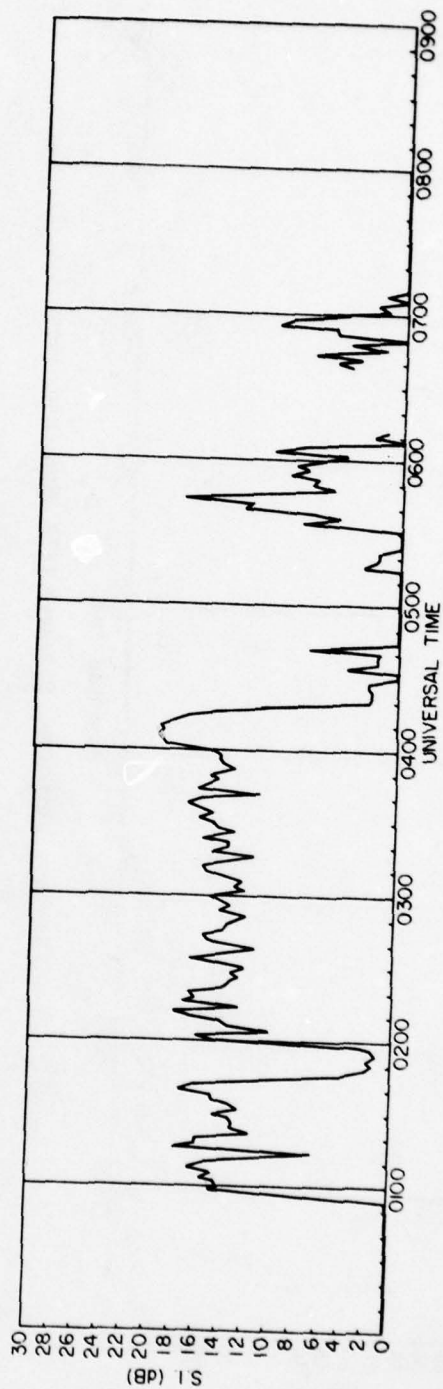


Figure 152. ATS-3, 136 MHz, 13 March 1978, Huancayo, Peru

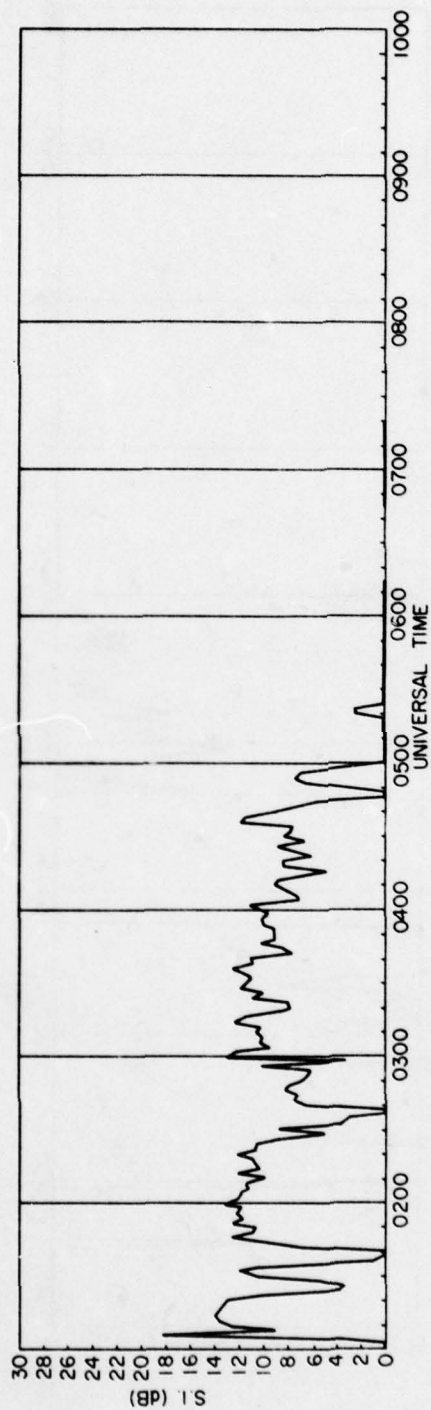


Figure 153. LES-8, 249 MHz, 13 March 1978, Huancayo, Peru

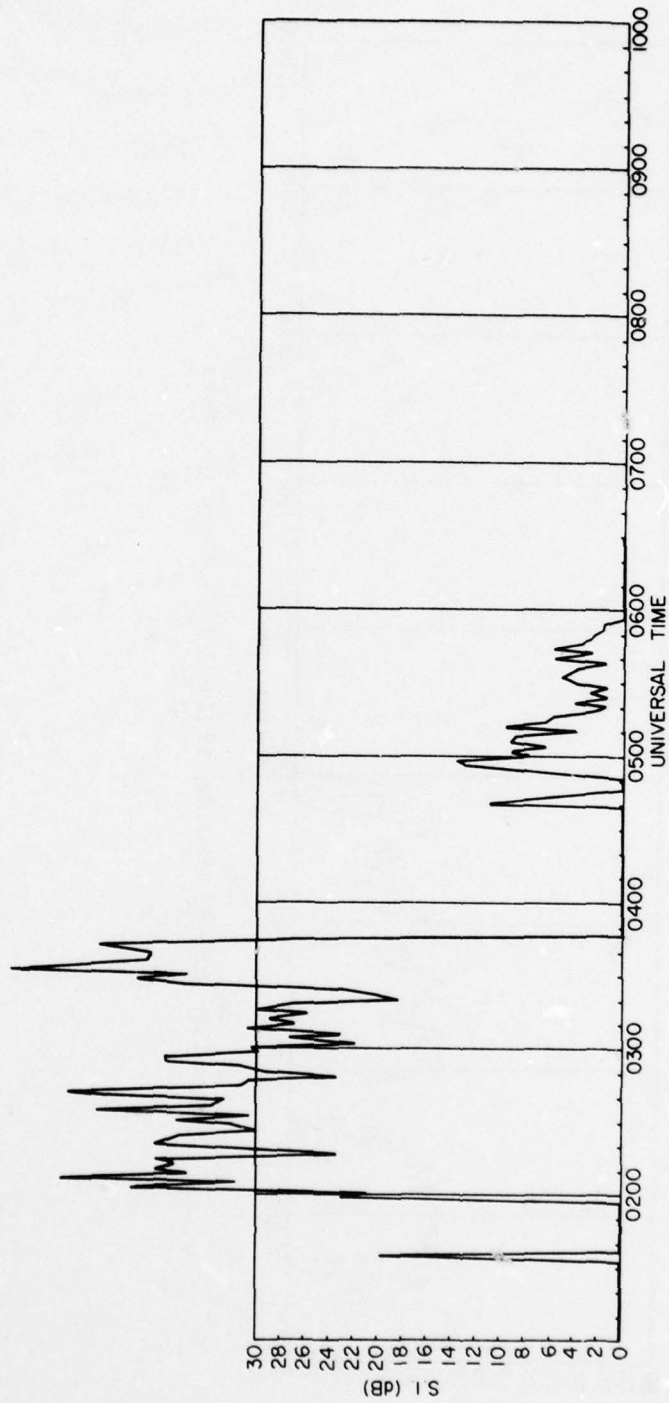


Figure 154. LES-8, 249 MHz, 13 March 1978, Ancun, Peru

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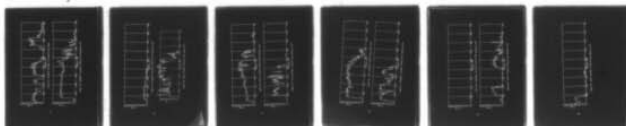
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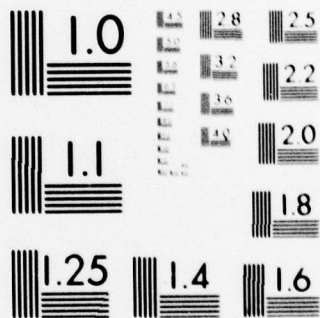
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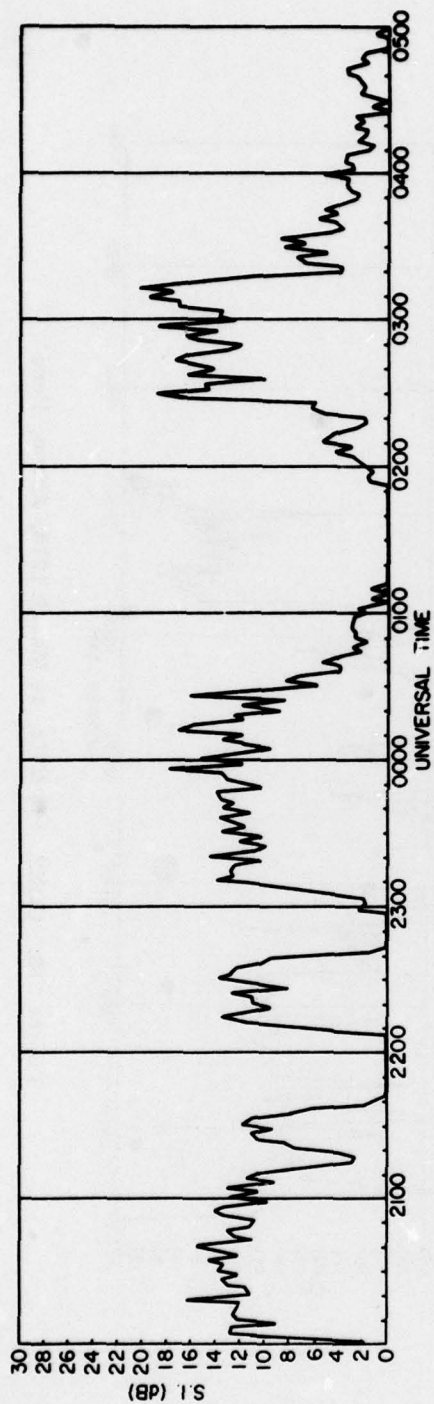


Figure 155. MARISAT, 257 MHz, 13-14 March 1978, Ghana

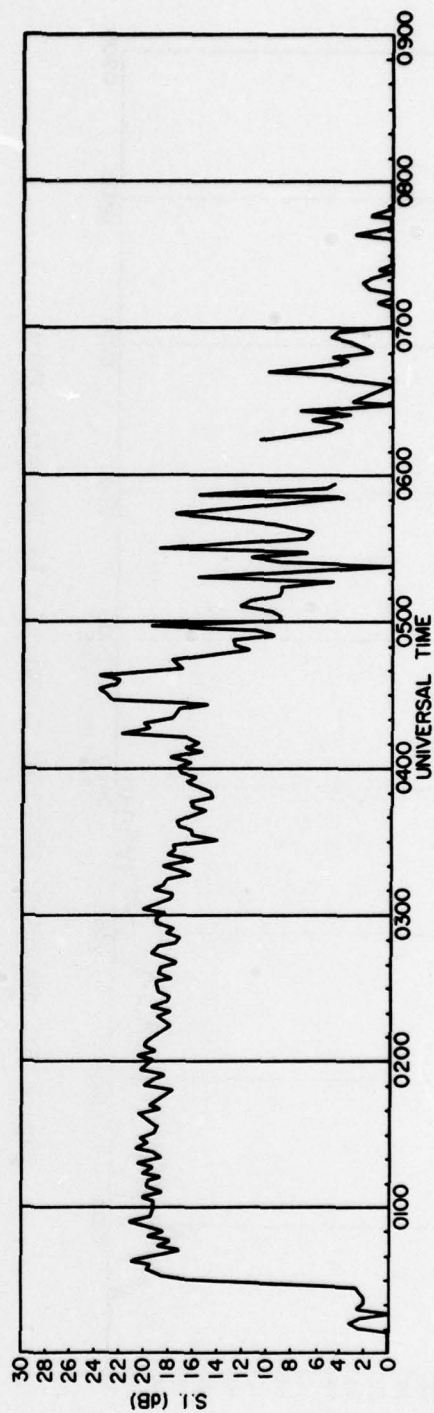


Figure 156. MARISAT, 257 MHz, 14 March 1978, Huancayo, Peru

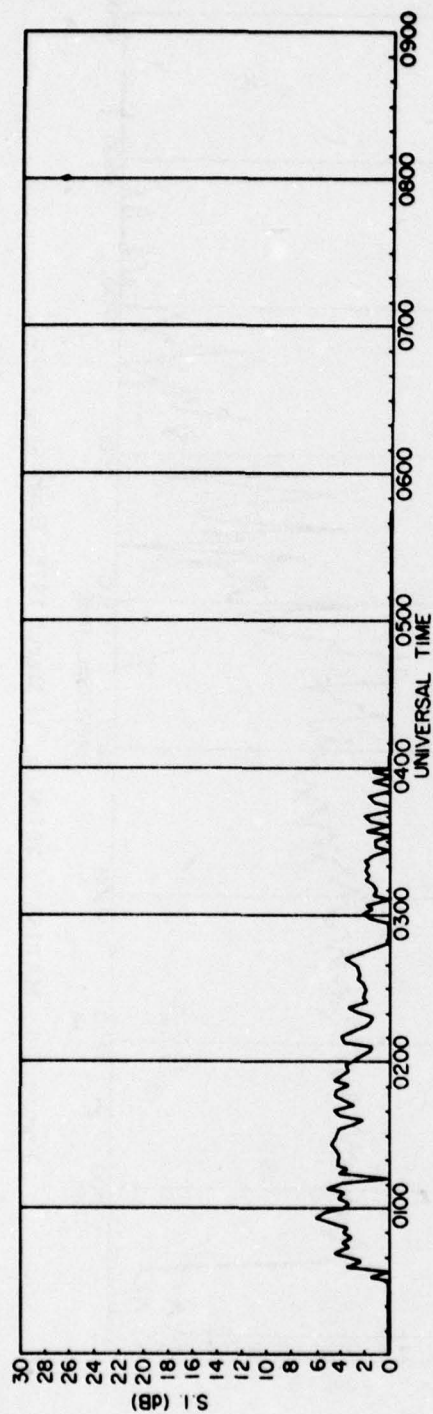


Figure 157. MARISAT, 1541 MHz, 14 March 1978, Huancayo, Peru

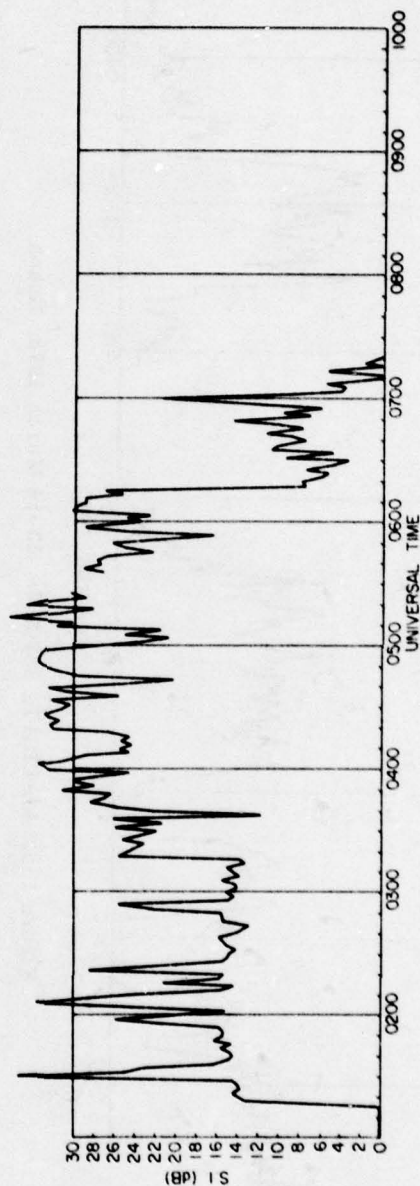


Figure 158. GOES, 136 MHz, 14 March 1978, Ancon, Peru

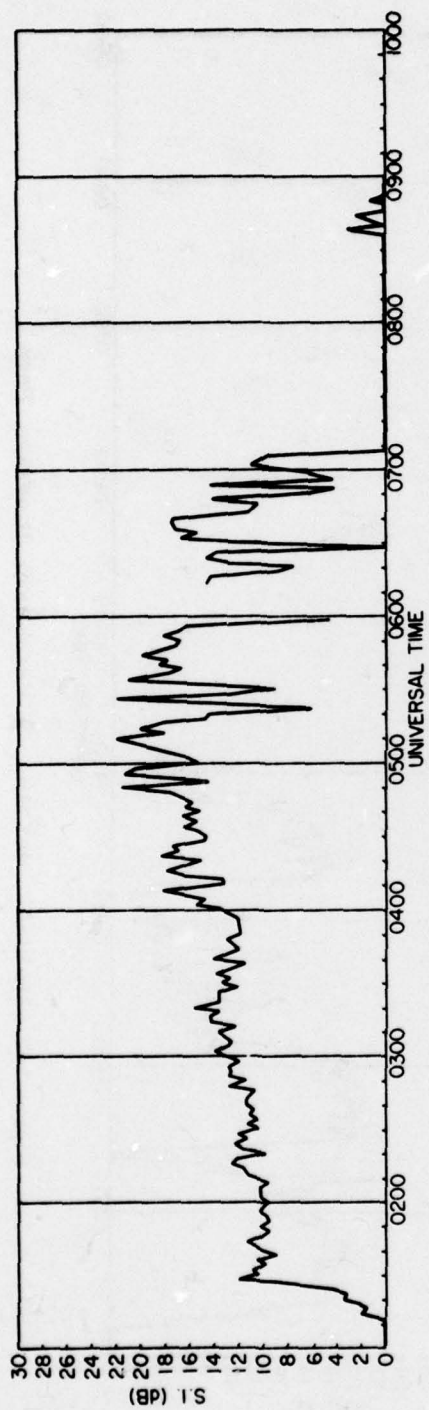


Figure 159. ATS-3, 136 MHz, 14 March 1978, Huancayo, Peru

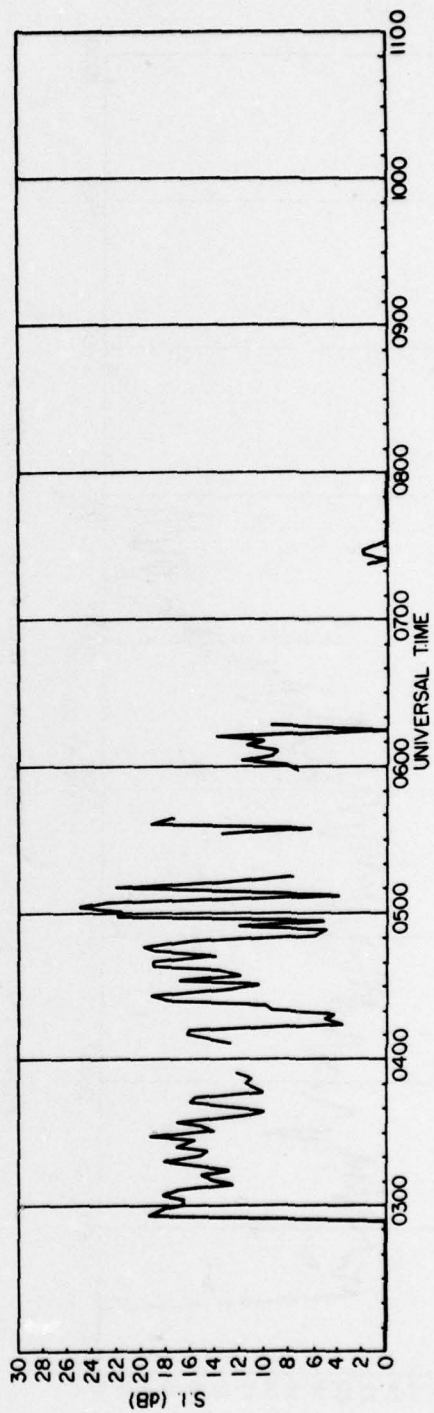


Figure 160. LES-8, 249 MHz, 14 March 1978, Huancayo, Peru

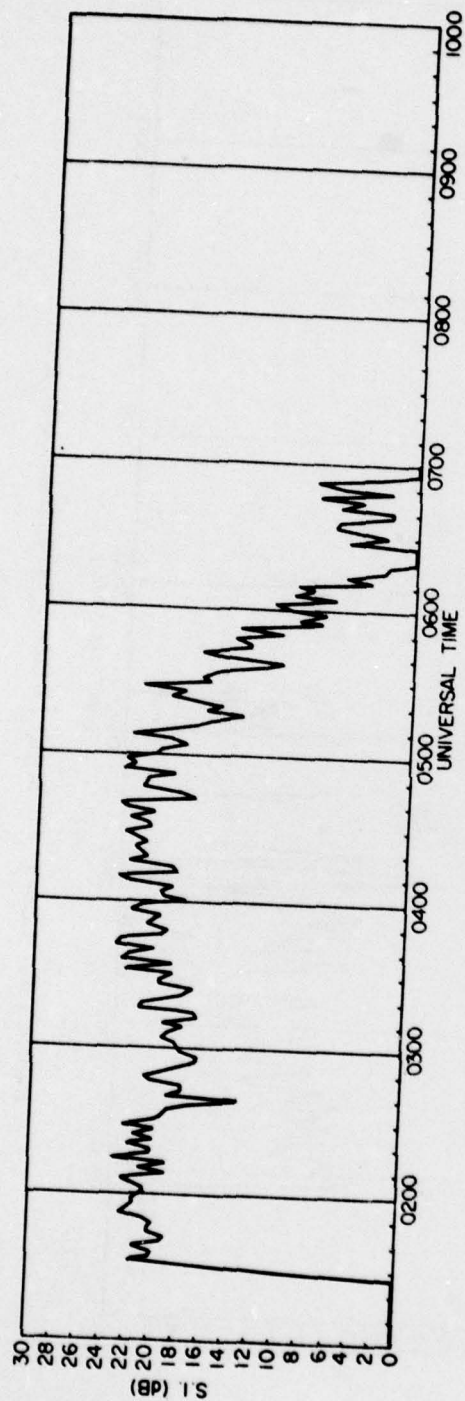


Figure 161. LES-8, 249 MHz, 14 March 1978, Ancon, Peru

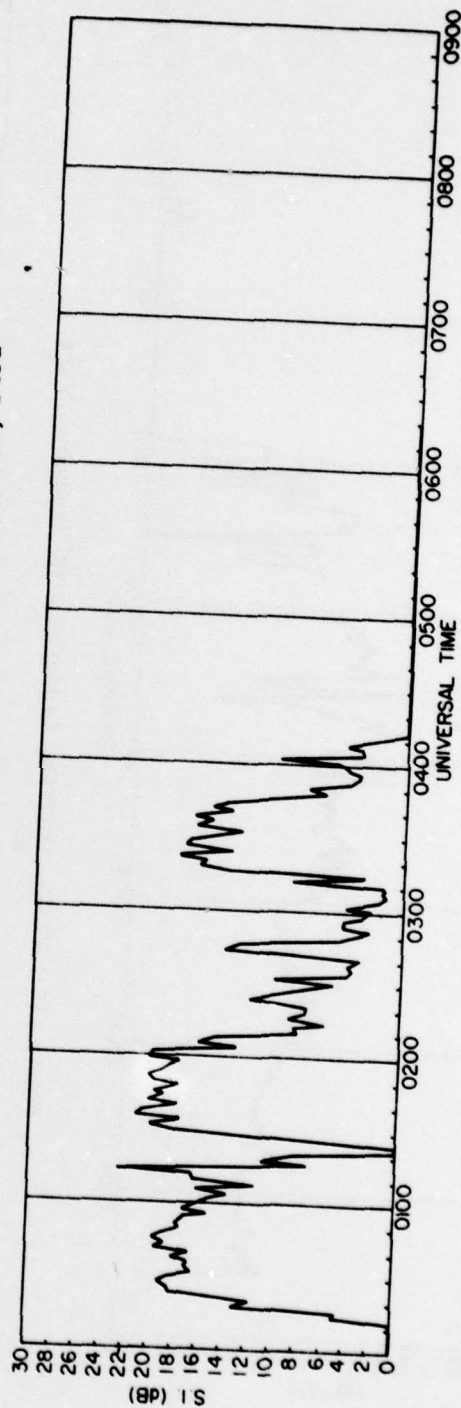


Figure 162. MARISAT, 257 MHz, 16 March 1975, Huancayo, Peru

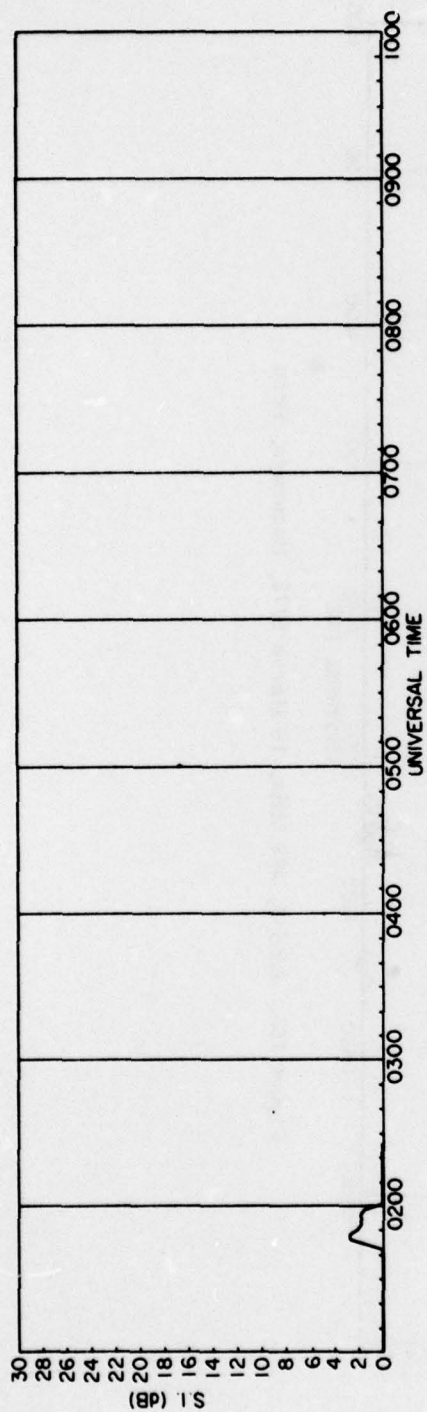


Figure 163. MARISAT, 1541 MHz, 16 March 1978, Huancayo, Peru

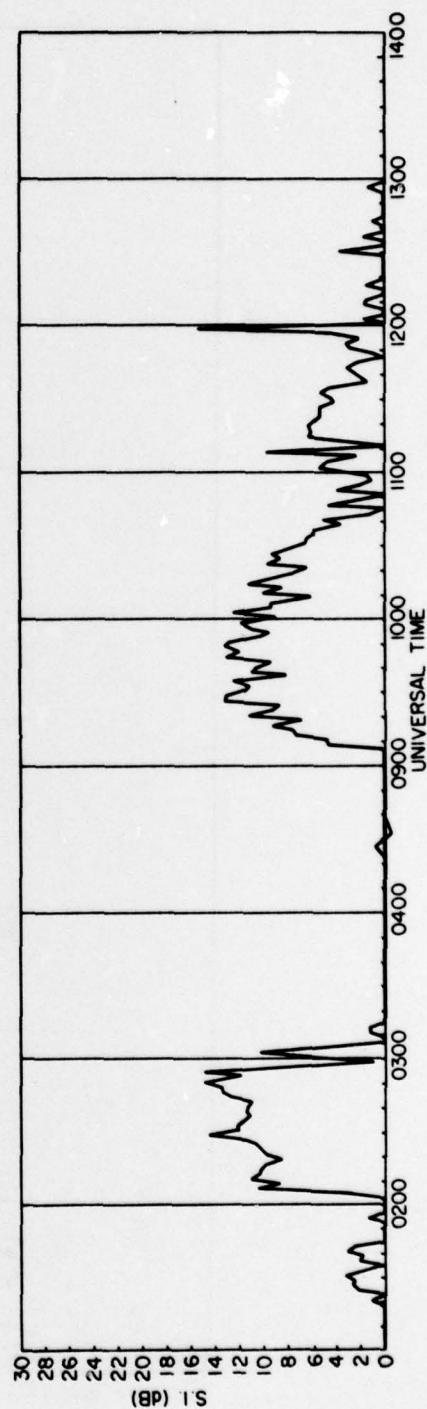


Figure 164. ATS-3, 136 MHz, 16 March 1978, Huancayo, Peru

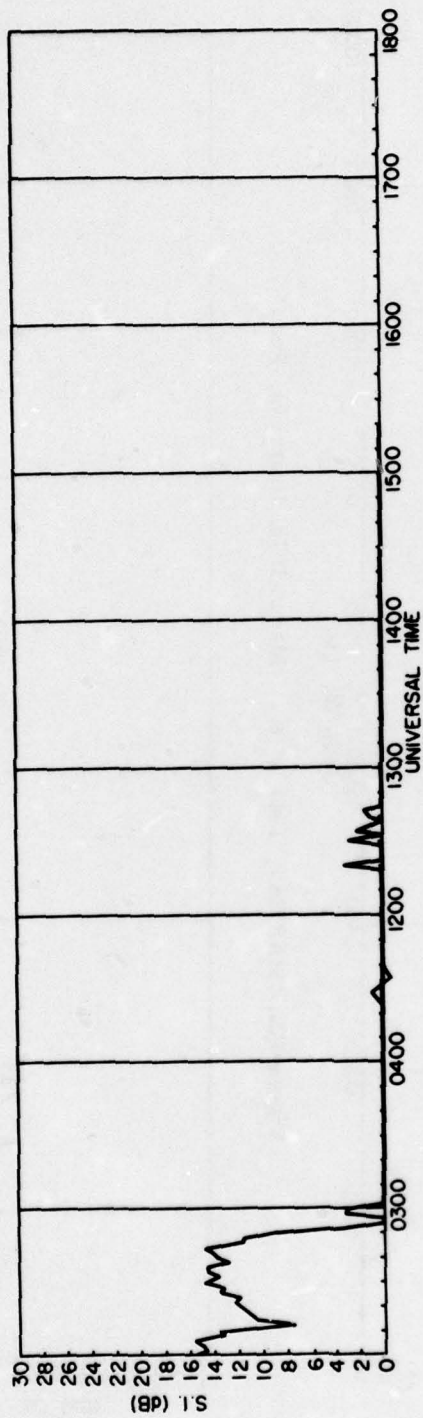


Figure 165. LES-8, 249 MHz, 16 March 1978, Huancayo, Peru